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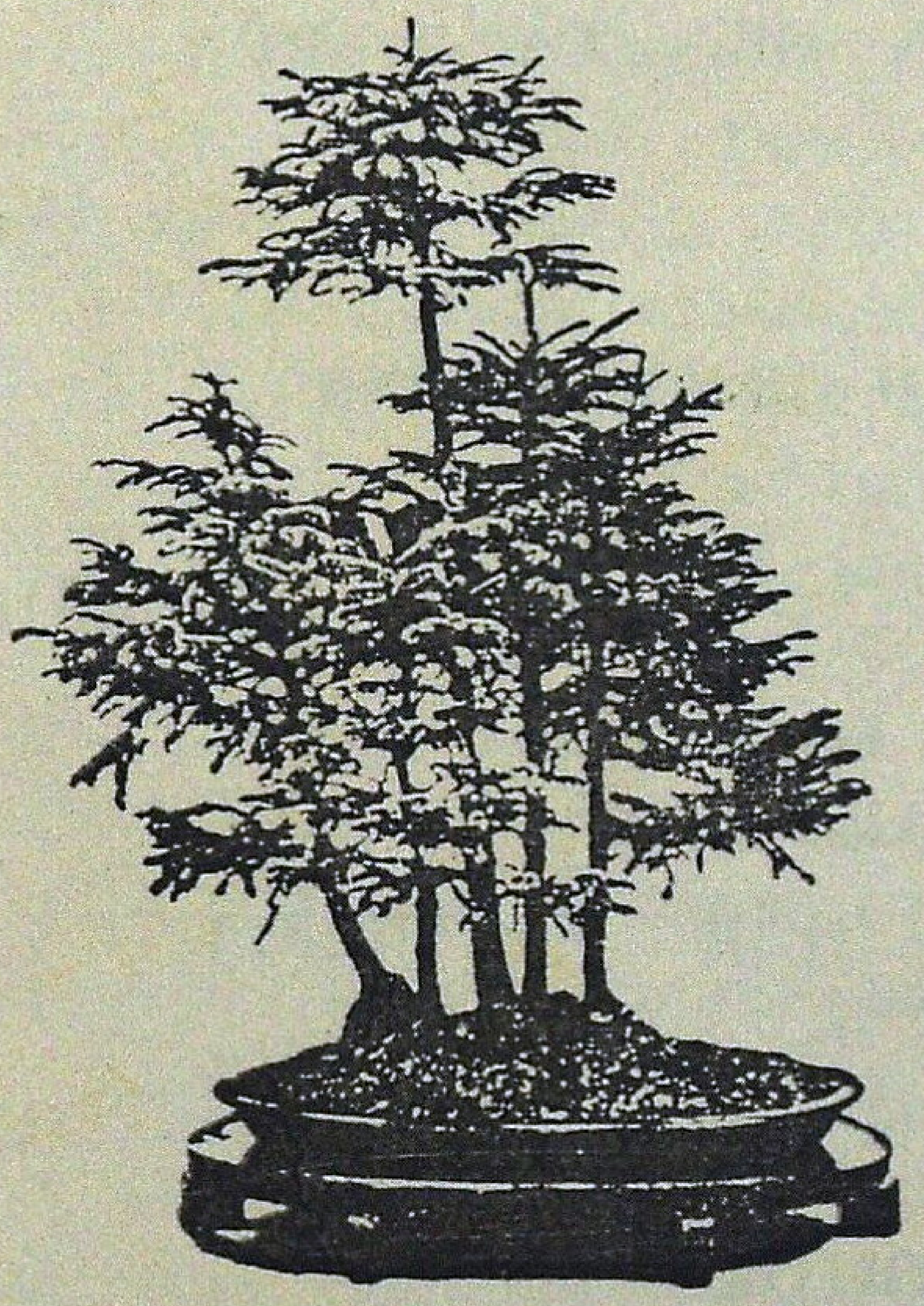

FRONT COVER

TAUNGYA PLANTATION OF *EUCALYPTUS* AND *SHOREA ROBUSTA* IN ALTERNATE ROWS AT COMPIER GANJ, GORAKHPUR FOREST DIVISION, GORAKHPUR (U.P.).

Photo—C.J.S.K. Emmanuel

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FOREST TREE IMPROVEMENT PROGRAMMES IN UTTAR PRADESH

CHANDRA GUPTA*, A.K. DWIVEDI** AND PADMINI SHIVKUMAR***

Introduction

Forest Tree Improvement is applied when control of parentage is combined with other Forest Management activies. It is not possible to develop long term tree improvement programmes without suitable, well planned genetic tests. Tree improvement is an additional tool of Silviculture that deals with the kind and genetic make up of the trees used in forest operations. Intensive Forest management activites, such as site preparation or fertilizations never will yield maximum returns, unless the genetically best trees are also used. Conversely, no matter how excellent trees may be genetically, maximum production cannot be achieved unless good forest management practices are used along with the improved plants.

There are three sources of variation, (1) developmental, (2) environmental and (3) genetic. Tree improvement through genetic manipulations is one of several means available for increasing forest production and the efficiency of conversion process. One major advantage of genetic improvement in forest trees is that once a change is obtained, it can be kept over a number of generations.

Tree improvement activities in Uttar Pradesh are undertaken in three Silvicltural regions i.e. Hills, Sal and Southern Regions (Fig. 1). The main species selected for Tree improvement work in these regions are given below :

(i) Silviculturist Hill Region : *Alnus nepalenesis*, *Cedrus deodara*, *Abies pindrow*, *Pinus roxburghii*, *Pinus walichiana*.

(ii) Silviculturist Sal Region : *Albizia lebbek*, *Holoptelia integrifolia*, *Shorea robusta*, *Syzygium cuminii*, *Adina cordifolia*, *Terminalia arjuna*, *Tectona grandis*, *Eucalyptus* hybrid, *E. citriodora*.

(iii) Silviculturist Southern Region : *Dalbergia sissoo*, *Prosopis juliflora*, *Acacia nilotica*, *Syzygium cuminii*, *Azadirachta indica*.

The system of work includes, provenance and plus tree selection, collection of seeds from selected trees, seed testing and quality assessment, raising seedling in the nursery, data recording in the nursery, progeny/provenance trials in the field with well laid out statistical designs, data recording every year, initially after 6 months, conversion of progeny/provenance trial in the long run to seed stand and then to seed orchard.

The present paper includes few details of the Tree improvement of *Dalbergia sissoo*, undertaken by the Forest Geneticist in the Forest Research Lab , Kanpur.

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Fig. 1

Hill, Sal and Southern Regions in Uttar Pradesh

Tree Improvement in D. sissoo : *D. sissoo* is one of the best timber species of India. Its timber values high for furniture, building construction and other uses. Poor stem-form with generally a crooked and forked bole, is the major drawback of Shisham trees. A great variability, however, exists in the growth and stem-form of Shisham (Vidakovic and Ahsan, 1970). This variation indicates that it is possible to improve this species by selection and breeding.

Selection of enough quality plus tree; improvement in the technique of vegetative propagation : Establishment of one parent progeny trials and development of controlled

breeding techniques should constitute the first phase of investigations in order to achieve an effective Improvement in stem-form and a moderate improvement in the growth. These methods adopted in the section are showing encouraging results.

Plus Trees : Plus Trees of Shisham have been selected from various regions in U.P., where both natural and plantation forests exists. They were selected with respect to the straightness of the stem, height and diameter growth. Few data of the selected plus tress of few regions are given in Table 1.

Progeny trials : Progeny testing of theselected tree is essential to assess its genotypic worth and breeding value.

In a one parent progeny trial conducted at Kanpur of the Shisham seeds brought from Mauranipur Range, Jhansi (U.P.), there was marked resemblance of the progenies to the parent type in straight stem-form. The parent plus tree measurement were : Height=28 m, Girth at B.H.=1.78 m and clear Bole height=9.0 m. The average values of the progeny are (3-4 year old plants) Ht=645.7 (cm), cl. B.H.=253.25 cm

Table 1

Few Plus Tree measurement of Dalbergia sissoo

Place	Height (m)	Clear bole height (m)	Girth (m)
Mauranipur Range, Jhansi	39.0	24.0	2.10
”	37.0	19.0	1.80
”	36.0	25.0	1.80
”	33.0	18.0	1.60
Bindki Range, Fatehpur	33.0	16.0	1.30
”	38.0	10.0	1.40
”	35.0	12.0	1.40
”	35.0	11.5	1.10
Fisher Forest, Etawah	19.0	6.65	1.40
”	18.6	8.0	1.90
”	13.4	3.3	1.22
”	13.0	1.75	1.17
Allen Forest, Kanpur	34.5	17.5	1.69
”	25.5	13.5	1.10
”	25.0	8.5	1.42
”	22.5	10.5	1.49
Brindavan Block, Mathura	19.0	8.0	1.42
”	18.9	7.5	1.46
”	17.9	6.0	1.29
”	19.5	9.0	1.55

and girth at B.H.=29.5 cm and that of the control plant was Ht. 327.08 cm, cl. B.H.=125.40 cm and girth at B.H.=13.58 cm, these control plants had both forking and crooked stem-form.

Genetics plays a major role in the development of stem-form. Shelbourne and Stonecypher (1968) found in both controlled and open pollinated families of loblolly pine with ages from two to five years and with height from three to twenty feet, that bole straightness is a heritable trait, which becomes more strongly genetically controlled with the increasing size of the tree.

Vegetative propagation by cuttings : Rooting of cuttings is the simplest and least expensive method of vegetative propagation. It is probably the only method by which clones of forest trees may be mass produced economically. We have been successful in propagating Shisham by cuttings without any kind of stimulators, for, the rooting of cuttings using hormone is expensive and inconvenient for practical silvicultural practices.

Stem cuttings taken from plus trees rooted well, however, high percentage of rooting was obtained in the cuttings taken from two to four year old plants. The time of planting is an important factor in the induction of rooting and February month was found suitable. By combining breeding of Shisham with vegetative propagation by cuttings, high improvement in the stem-form and a moderate improvement in the growth can be made.

Provenance trials : Provenance test is a good way to start an improvement programme. They are considered to be an essential part of the genetic improvement work. Tree improvement in the sense of species provenance selection and breeding can contribute directly to increased net economic yield through increasing average growth rate.

Provenance trials of *D. sissoo* have been laid out at Parag Dairy premises, Kanpur in Oct. 1987. Provenances included in the trials are Etawah, Orai, Jhansi, Fatehpur and Makdampore (Unnao) all in the Uttar Pradesh Region. (Table 2) The design of the experiment was R.B.D. with 4 replications.

Table 2 gives the measurement of mean height, diameter and clear bole height of

Table 2

Preliminary provenance trial data (Kanpur)—Dalbergia sissoo

Provenance	1 year old		3 years old	
	Average Height (m)	Average Diameter (cm)	Average Height (m)	Average Diameter (cm)
Etawah	4.79	4.53	7.75	14.97
Orai	3.49	4.00	7.33	12.82
Jhansi	4.99	4 86	7.88	15.13
Fatehpur	3.22	4.28	7 78	14.14
Unnao	4.59	4 38	7.75	15.00
Control	2.22	2 63	5.25	9.08

one year old and three years old plantations in the field. Preliminary provenance trial data and observation in the field showed marked differences among the provenances, and also variation in the stem-form. Selection gain is being worked out for this trial.

Conclusion

Numerous special studies on economic relationship have all come up with the conclusion that Tree improvement is an excellent investment and returns are greater than for most forestry expenditure.

SUMMARY

In U.P., Tree Improvement Programme is being undertaken in the three regions of Silviculture i.e. Hills, Sal and Southern Region. This paper includes the improvement programme of Shisham being carried out in the Forest Genetics Section, F.R.L., Kanpur. The preliminary results indicate that there are advantages in Forest Tree Improvement Programmes.

उत्तर प्रदेश में वन वृक्ष सुधार कार्यक्रम

चन्द्रगुप्त, ए०के० द्विवेदी व पद्मिनी शिवकुमार

सारांश

उत्तर प्रदेश में वृक्ष सुधार कार्यक्रम तीन वन संवर्धन क्षेत्रों अर्थात् पर्वतीय, साल, दक्षिणीय क्षेत्र में कराया जा रहा है। प्रस्तुत अभिपत्र में वन आनुवांशिकी अनुभाग, वन अनुसंधान प्रयोगशाला, कानपुर में किए शीशम के सुधार कार्यक्रम को लिया गया है। प्रारम्भिक परिणामों से संकेत मिले हैं कि वन वृक्ष सुधार कार्यक्रम से कई लाभ होंगे।

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STRATEGIES FOR THE IMPROVEMENT OF FOREST TREE SPECIES — SOME CARDINAL PRINCIPLES

P.N. MEHRA*

Introduction

Nature has endowed India with vast forest wealth of great diversity, varying from tropical evergreen forests to dry alpine forests containing over 300 genera and 700 species of forestry value. Due to their large geographical extension and the number of people involved in their use and management, forest resources are essential ingredients in any strategy for sustainable national development. These resources are depleted day by day due to over exploitation. This fact is evident from the State Forest Report of 1989 brought out by the Forest Survey of India indicating that actual forest cover is only 64.01 million hectare, which comprises of both wood and hardwood species. To meet the ever increasing demand of these species for human needs it is essential to increase the productivity of our forest plantations. This can only be achieved through improvement of forest tree species.

Softwoods

Softwoods appeared on the surface of our planet nearly 300 M years back, in the Carboniferous periods. In late Jurrassic and Cretaceous some 100-150 M years back, they formed the chief constituents of the forests of the world. They are now represented by 52 genera and nearly 500 species. Of these 29 species included in 11 genera are met with in India, all confined to the Himalayas. The most important of these from forestry point of view are species of *Pinus*, *Cedrus*, *Picea*, *Abies* and *Larix*. A cytological analysis of the world softwoods, including Himalayan ones, reveals that barring *Sequoia sempervirens* or the red wood–at present confined to a small strip of the west coast of California–which is an all–hexaploid (2n=66 chromosomes), all the rest occurring in nature are at the diploid level, even though they had ample opportunities of evolving polyploid types by multiplication of genomes through the ages. In an earlier evaluation of the situation Mehra (1960) had postulated a physiological concept "The Saturation Hypothesis" which envisions that in any system only a limited number of genomes can function to advantage in specific cytoplasm for optimum results. This concept was deduced from observations in nature where evolutionary diversity has occurred through milleniums without multiplication of genomes. This has now turned out to be fully supported by exprimental trials of induction of polyploidy through the application of colchicine or similar agents. The tetraploids thus produced in Pines at Placerville (Hyun, 1954) and in some other conifers in Japan have been a

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dismal failure. The diploids are far superior in performance compared to the tetraploids which are sickly, gnarled and have no survival value, let apart their usefulness for timber production. In Pines and other conifers the evolutionary diversity in nature has only been at the diploid level through hybridisation and recombination of genes and through intrinsic gene mutations resulting in the production of ecotypes, morphotypes and diverse provenances. At Placerville as a result of the activities of Righter and Duffield (1951 a,b) artificial hybridisations and recombination of genes in Pines, which too involved heterotic vigour, has been achieved for the production of superior types for afforestation. This is the only practical method for improvement of conifers which needs to be followed anywhere for gainful accomplishments of planted forests.

Hardwoods

Hardwoods seem to behave differently. They came into existence much later than the softwoods. The earliest record of their existence is in the Mesozoic period, to be more precise in the Jurrasic, about 150 M years back, but thereafter their diversification has been rapid. We had an opportunity of making detailed cytological analysis of woody species occurring in the tropical and temperate forests of the Himalayas for a period of 5 years, the results of which were published in a series of papers in international journals, culminating in a comprehensive monograph (Mehra, 1976). The tree species fall into two groups, (1) those that are conservative in their chromosomal constitution, like the softwoods, exhibiting the same chromosome number in species after species. They have evolved in nature only at the diploid level. To this category belong Oaks, Laurels, Walnut, Maples, Champak, Albizias, Dalbergias and Xylias which are our important timber species. Taking cue from nature and based on experimental evidences revealed in the case of conifers, it would be futile to improve upon their forestry importance through raising of polyploids since physiologically speaking saturation has already occurred at the diploid level. They are amenable to vast amount of improvement only through hybridisation and recombination of genes of the compatible races and provenances followed thereafter by selection. Piatnitsky (1960) performed 200,000 hybridisation in 47 different combinations with *Q. macrocarpa* as the female parent and *Q. rubur*, *Q. macrocarpa* and *Q. alba* as the male parents, and obtained excellent results in combining useful traits and introducing hybrid vigour. More recently Geary *et al.* (1973) have produced hybrids between *Swietenia mahogany*, *S. macrophylla* and *S. humilis*. These hybrids have exhibited growth characteristics superior to the parents. There are a few other instances of similar type. Some of our prize woods like Teak, Sal, Sandalwood, Red Sanders, Walnut, Albizias from different ecological and geographical ranges could profitably be used for hybridisation to advantage. In these the production of polyploids are not likely to yield profitable results.

(2) To the other group belong a variety of genera and species which exhibit polyploidy in nature. The polyploids occur both at the interspecific and intraspecific levels. Obviously their genomes can function properly in the specific cytoplasm even if they are

present at multiple or polyploid levels. Such is the case in *Morus*, *Canarium*, *Magnolia*, *Eugenia* where interspecific polyploidy is exhibited and in *Erythrina suberosa*, *Terminalia belerica*, *T. chebula*, *Eugenia jambolana*, *Celtis australis*, *Betula utilis* and a number of *Salix* species which show interspecific polyploidy that is responsible for the formation of varieties, races and provenances. In such genera and species it will be appropriate to have recourse to experimental production of polyploids to suit specific conditions.

Populus tremula is known to show 36% increase in wood in triploid compared to diploid. Johnsson (1959) in *Betula verrucosa* and Ehrenberg in *Alnus glutinosa* produced triploids by crossing artificially raised tetraploids (using colchicine) with diploids. They were more vigorous than either of the parents. However, triploidy coupled with interspecific hybridisation is even better than autotriploidy. Triploids between *Populus tremula* (4×) × *P. tremuloids* (2×) produced by Johnsson (1959) were found to be better than autotriploid *P. tremula*. Likewise triploids between *Alnus rubra* (2×) × *A. glutinosa* (4×) have shown much better results than *A. glutinosa*. Raising of polyploids are hence useful provided we judiciously select species belonging to genera in which polyploidy occurs in nature.

Are the polyploids better than the diploids in respect of wood characteristics? An analysis to this effect of the naturally occurring species was made by us some years back (Mehra and Hans, 1972). It was found that whereas polyploids are rapid in growth compared to diploids, by and large the strength and durability of wood was inferior to those of diploids. Raising polyploids for fuelwood would hence seem to be appropriate in consideration of the rapid growth, but for constructional timber species this would be counter-productive in respect of the wood quality. While this seems to be the general rule, in the ultimate analysis much depends on the genetic outfit of the species. *Bischofia javanica* is a very high natural polyploid (2n=196, 28-ploid) but yields excellent timber indicating that genotype is of paramount importance in governing the quality of wood.

Mass Propagation : When once we have selected an elite either from nature or have synthesised it through hybridisation or have produced a polyploid of desired nature, the next question is the mass multiplication of such elites. For this purpose the *inherent potentiality* of the species is of great importance. There are tree species which are easy to root from cuttings such as *Salix*, *Populus* and many others, whereas there are others which are hard to root. This is an excellent index for selecting species for rapid mass multiplication through the employment of tissue culture technique. We have experience in this direction on *Populus* species. It has been possible to produce indefinite number of plantlets in *P. ciliata* and *P. alba* the common Himalayan poplars within a short period, from a single selected elite (cf. Mehra and Cheema, 1980). Tissue culture technique abbreviates the time factor for mass multiplication. Besides this technique produces individuals true to type which is not the case if one were to grow the crop from seeds. Seeds are heterozygous because of the proverbial wind pollination or anemophylly in almost all the tree species.

Monoculture—a fallacy : I do not believe in monoculture for planted forests for a variety of reasons. Firstly, if an epidemic breaks out a fungal attack or insect pest-particularly at the sapling stage, it will have a devastating effect on the whole population. Equally importantly is the interaction of root systems upon one another. If there is the phenomenon of allelopathy where the exudate from the root-system of certain species are deleterious to the growth of some others, the reverse i.e. the promotional effect is equally feasible. For this purpose a mixed culture of elites of different species, *simulating what exists in nature* in respect of the composition of the species in natural forests, is to me a highly desirable strategy.

SUMMARY

Hybridisation, recombination of gene of the compatible races and provenances followed by selection has been suggested for softwoods and some of the hardwoods like Oaks, Laurels, Walnut, Maples, Champak, Albizias, Dalbergias and Xylias. To improve timber species like Teak, Sal, Sandalwood, Red Sanders, Walnut and Albizias hybridisation has been suggested between different ecological and geographical races. Polyploidy has been suggested for *Morus, Canarium, Magnolia, Eugenia, Betula, Terminalia* and *Salix*. Mass multiplication of such elites can be raised either through rooting of cuttings or tissue culture technique for planting mixed culture forests, simulating what exists in natural forest.

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पी०एन० मेहरा

सारांश

सकरण, मिल सकने वाली जातिकाओं और स्थानभेदों की जीनों का पुर्नसयोजन और उसके पश्चात् उनमें से चयन करना ये कुछ उपाय हैं जिन्हें मृदुकाष्ठों और कुछ कठोर काष्ठों जैसे बाँज, लारेल, अखरोट, मैपल, चम्पक, एल्बिजिया, डलबर्गिया और जीलिया प्रजातियों के लिए सुझाया गया है। सागौन, साल, चन्दन, रेड सेंडर्स, अखरोट और एल्बिजिया की जातियों जैसी प्रकाष्ठ जातियों में विभिन्न पारिस्थिकीय और भौगोलिक जातिकाओं में सकरण कराने का सुझाव दिया गया है। मोरस, केनेरियम मैग्नोलिया, युजोनिया, बिटुला, टर्मिनेलिया और सेलिक्स प्रजातियों में पुरुगुणता अपनाने का सुझाव दिया गया है। ऐसी जातियों के श्रेष्ठ वृक्षों का सामूहिक पुरुजनन उनकी कलमों में जड़ें निकलवा कर अथवा ऊति सवर्धन प्रविधि द्वारा मिश्रित सवधन वन लगाने के लिए किया जा सकता है जो वैसे हो हो जाएंगे जैसे स्वाभाविक वनों में देखने को मिलते हैं।

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NATURAL DISTRIBUTION, REGENERATION AND GROWTH STATISTICS OF POPLARS IN ARUNACHAL PRADESH

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Introduction

Poplars are fast growing tree species with great scope in the forestry of Arunachal Pradesh. Other than the introduced ones, there are two species viz. *Populus gamblei* Dode and *P. ciliata* Royle naturally occurring in Arunachal Pradesh The former is distributed at comparatively lower elevations i.e. between 500-1600 m whereas, the latter occurs between 1200 m to 3500 m in the higher reaches. Their distribution, propagation, growth pattern, etc. differ from each other. *P. ciliata* is faster in growth, easily propagated by vegetative means and is often cultivated by the farmers along the boundary of their fields. Forest Department also has raised some plantations. Due to their fast growing nature and suitability to grow at higher elevations where other slow growing species occurs in general, poplars are best suited in afforesting higher altitudinal zones.

Exotic poplar (*P. deltoides*) was also tried in the lower zone (150 m elevation) of the State under irrigated condition. A number of clones were tried of which G-3 performed better. However, their growth after one year was not satisfactory even under irrigated condition.

The present paper deals with the distribution, regeneration and growth statistics of different poplar species and clones under experimental trials in Arunachal Pradesh. As the altitude, climate etc. vary widely in Arunachal Pradesh and they greately influence the distribution and growth of poplars, a brief account of geography and climate is also given.

Geography

Arunachal Pradesh lies between 26°40′ and 29°28′ N latitude and 91°38′ and 97°24′ East longitude and has an area of 83578 km². It has common boundary in the North with China, East with Burma, West with Bhutan and South with Assam and Nagaland. It has the largest geographical area among the north eastern States. The State is predominantly hilly and altitude ranges between 160-4000m.

Geology and Soil

Geologically Arunachal Pradesh is part of the Himalayas. The main body is considered to be of the gneissic-type of rocks while the outer parts are composed of several types of metamorphic rocks with phyllites, schists, quartzites, slaty shale, limestone and others. The river belts are cut through massive boulders of gneiss and are predominantly sandy, mixed with stony pebbles whereas hill range consists of brownish, black alluvium of laterite-type. Valleys comprise

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mature alluvial deposits (Rao, 1972). Eastern part of the territory consists of clayey soil and the rest is sandy to sandy loam soil with pockets of clay.

Climate

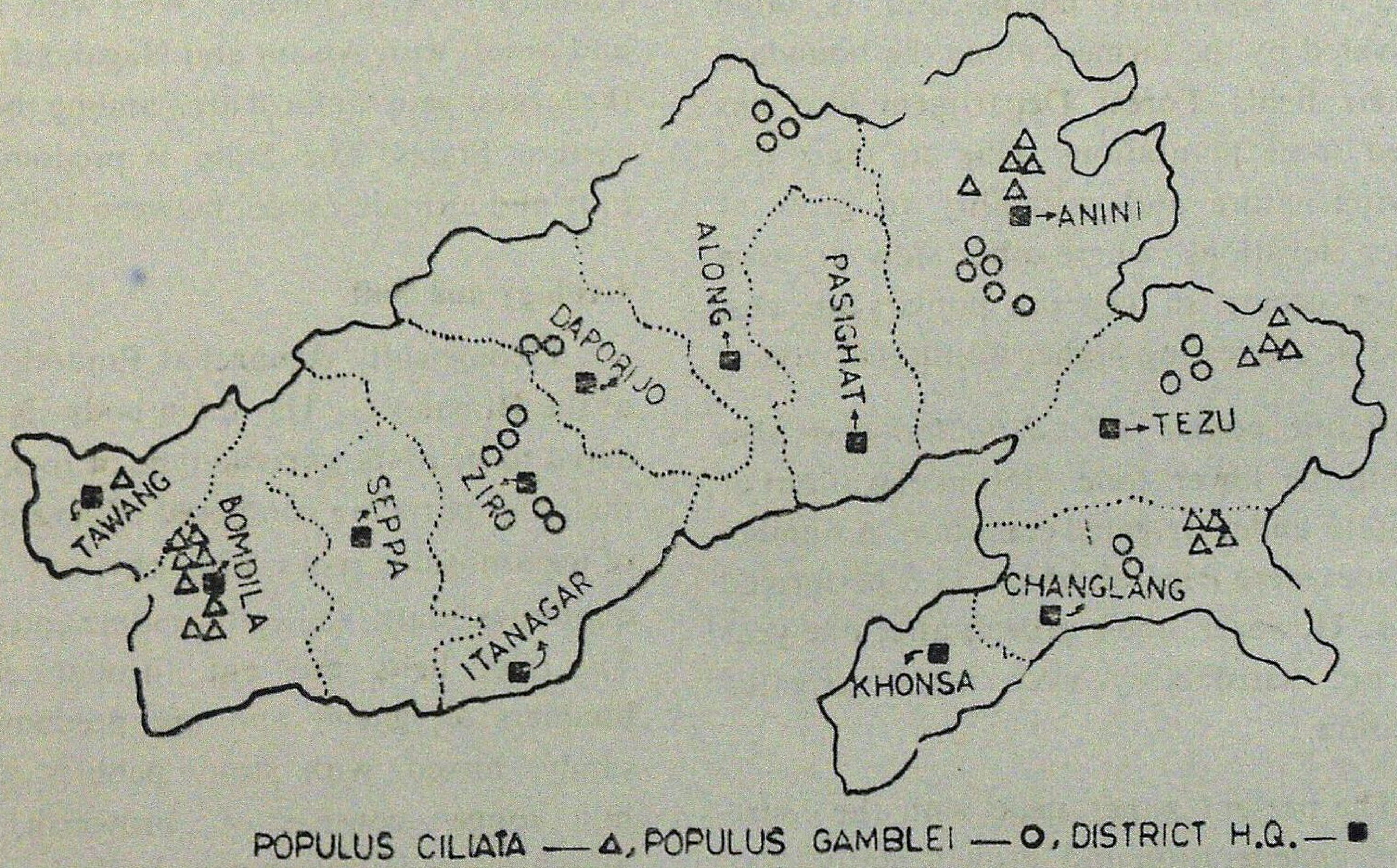
The climate of the State is tropical but due to geographical features, it has tropical, sub-tropical and temperate climates. There are two distinct seasons viz. rainy and winter season, rainfall often ranging between 1000-6500 mm, which decreases from east to west and is fairly distributed through out the year without any dry month. However, the maximum concentration of rainfall is during the months of May to September. Temperature vary considerably according to altitude. In foot hills, it varies from 25°-36°C (Summer), 6°-10°C (Winter) and in higher reaches 15°-30°C (Summer) and -5°C to 3°C (Winter). At higher peaks the minimum temperature goes further below during the winter.

Natural distribution

Populus species are distributed naturally over the sub-tropical and temperate zones of Arunachal Pradesh (Fig 1). In general *Populus ciliata* is seen at higher altitudes compared to *P. gamblei* which is seen along the lower limits of *Populus* distribution.

P. ciliata : Distributed through out the State between 1600-3500 m elevation. However, they are more frequent in West Kameng, Tawang, Dibang Valley, Lohit and Changlang Districts. The areas of major concentrations are Jigaon, Shergaon, Bomdila, Dirang, Baishakhi, Tawang etc. in West Kameng and Tawang Districts. Anini in Dibang Valley District, Malinja-Simbi in Lohit District,

Fig. 1



Map of Arunachal Pradesh showing distribution of poplars (not to scale)

higher reaches of Namdapha in Changlang District etc. The species attains girth of 4 m and height over 35 m. At many places the species is seen as pure stands (Kaul and Haridasan, 1987). Often it is associated with other temperate species. The main associates are *Pinus roxburghii*, *P wallichiana*, *P. merkusii*, *Abies densa*, *Tsuga dumosa*, *Quercus* spp., *Michelia* sp., *Magnolia campbellii*, *Rhododendron* spp., *Pyrus* sp., *Acer* spp., *Alnus nepalensis*, *Betula alnoides*, *Salix* sp., etc. *Berberis* spp., *Rubus* spp., *Lyonia ovalifolia*, *Gaultheria* sp. *Daphne* sp., *Desmodium* spp., are some of the lower storey plants occurring under *Populus ciliata*.

P. gamblei : *Populus gamblei* is found in Lower Subansiri, Upper Subansiri, West Siang, Dibang Valley, Lohit and Changlang Districts. It is more commn in Lower Subansiri and Dibang Valley and is coming up well in association with *Schima wallichii*, (Lower Subansiri) *Alnus nepalensis*, *Castanopsis* spp., *Quercus* spp., *Lindera neesiana*, *Albizia* spp., *Pinus* sp., Photinia sp., *Morus laevigata*, *Ficus* sp., *Saurauia* sp., etc. It attains girth of about 2 m and height over 28 m.

Regeneration

Populus ciliata seeds during second week of July and *P. gamblei* during last week of February or first week of March (Beniwal, 1987). Natural regeneration of both the species is profuse specially on freshly turned soils and land slips. Seeds tried in the nursery for both the species gave very poor germination. Vegetative propagation methods have been tried for these species to raise plants in nursery which are as follows :

P. ciliata : Nursery plants are raised by three methods :

(1) *Local method* : Long branch cuttings are buried in the soil during February/March and some cuts are given on the branches so that the rooted branches can be separated if required for planting at other places or they are left as such to grow *in-situ* along the fencing of the field. In one season the sprouts from the cuttings attain average height of 35 cm with a maximum of 48 cm.

(2) *Plants raised in bed* : Cuttings of 20-25 cm long are planted during March in the nursery bed keeping one or two buds above the ground. The cuttings sprouts in 30-35 days and attain an average height of 146 cm with a maximum of 1.72 m in one growing season. These plants are planted out in the field during February/March where irrigation facilities are available.

(3) *Plants raised in poly bags* : Cuttings of 20-25 cm long are planted in the polythene bags during March. These plants attain 40-45 cm height by June/July of the same year and are then planted in the field during rainy season. These plants are mostly used in afforestation works where irrigation facilities are not available.

P. gamblei : It is very difficult to propagate through cuttings due to poor sprouting (Ghosh and Bhatnagar, 1977). Hence the root suckers are used for raising planting materials. There is also scope to raise plants from seed. Germination has been reported (Palit, 1980) very good when the seeds were sown in trays. Seedlings attain about 6 cm after one month of seed sowing and are plantable by July by that time seedlings attain an average 52 cm height.

Growth data

Growth data (average of 25 plants of each) of some of the plantations raised by different types of planting materials is given in Table 1.

Table 1

Growth data of P. ciliata and P. gamblei

Species	Type of planting material used	Age of plantation (year)	Location	Average girth (bh) (cm)	Average height (m)
Populus ciliata	Local method plants	16	Bomdila	72.94	27.85
,,	-do-	11	-do-	43.26	11.29
,,	Polybags plants	1	-do-	4.3 (collar girth)	0.61
,,	-do-	2	-do-	10.0 (collar girth)	2.06
,,	Bed raised entire plants	2	Dirang	9.0 (collar girth)	3.26
P. gamblei	Root suckers	16	Yachuli	70.44	24.4

SUMMARY

Populus ciliata **and** *Populus gamblei* **are the two common poplars seen in Arunachal Pradesh. Their natural regeneration over the sub-tropical and temperate forests are very good. They come up well an exposed freshly turned soils, land slips, etc. They can be easily raised vegetatively by using branch cuttings and root suckers quick to establish, fast growing and profusely coppicing. All these characters suggests suitability in agroforestry, soil conservation and jhum reclamation work in Arunachal Pradesh for which there is a vast scope in the State.**

अरूणाचल प्रदेश में पोपलरों (वन पिप्पलों) के प्राकृतिक वितरण, पुनर्जनन और वृद्धि के आंकड़े

बी०एस० बेनीवाल व के० हरिदासन्

सारांश

अरूणाचल प्रदेश में आमतौर से पाए जाने वाले दो वन पिप्पल हैं पापुलस सिलियाटा और पापुलस गम्बलेई । उपोष्ण और समशीतोष्ण वनों में इनका प्राकृतिक पुनर्जनन बहुत अच्छा रहा है । खुल कर बाहर आ गई ताजी पलटी मृदाओं, टूटकर खिसकी भूमि में ये बहुत अच्छे उग जाते हैं । शाखाओं की कलमों और जड़ों से इनका वर्धीप्रवर्धन आसानी से हो जाता है, ये जल्दी से स्थापित

हो जाते हैं, शीघ्रवर्धी और प्रचुरता से स्थूण-वर्धित होने वाले हैं। इनके ये सभी गुण अरूणाचल प्रदेश में कृषि वानिकी, वृक्ष संरक्षण और झूम क्षेत्रों के पुनरसंस्कार कार्यों के लिए, जिनके लिए इस राज्य में बहुत अधिक कार्य क्षेत्र है, इसकी उपयुक्तता का सकेत देते हैं।

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COMPONENT - WISE BIOMASS MODELS FOR TREES : A NON - HARVEST TECHNIQUE

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Introduction

Biomass estimation is a prerequisite to initiating study on ecosystem functioning. Increasing atmospheric CO_2 concentrations also necessitates assessment of Carbon storage in forest biomass. Allometric equations, relating biomass with one or more tree dimensiones (e.g. circumference, height ete.) are frequently used to compute average tree biomass (Whittaker and Woodwell, 1968). Generation of such equations involve felling of trees (Chaturvedi and Singh, 1983; Negi *et al.*, 1983; Rai, 1984; Rawat and Singh, 1988) which is sometimes impractical in certain situations, particularly in environmentally sensitive areas. Thus, it is required to adopt a technique for generation of biomass estimation equations, which is least detrimental to the trees and bears a reasonable and acceptable level of accuracy. Present study describes a non-harvest technique for generation of biomass estimation equations through example of five tree species occurring in Siwalik hills around Dehra Dun, Uttar Pradesh.

Material and Methods

The study was conducted in Rajaji National Park (29°50′ to 30°15′ N lat. and 77°55′ to 78°30′ E long.) near Dehra Dun. Five species viz., *Shorea robusta*, *Terminalia tomentosa*, *Terminalia chebula* and *Mallotus philippensis*, were selected. The representative trees from various girth classes were selected for sampling. The number of selected trees represented the distribution of trees in various girth classes. Individual trees were measured for circumference at breast height (cbh), length of bole, length of major branches and their circumference at the base. The major branches were the five lowest (and hence the oldest) branches. The remaining branches of the tree were considered as minor. For two of the major branches total number of twigs were counted. A few representative twigs were sampled. Leaves were separated from the twigs. Twigs and leaves were measured for fresh weight. The weighed sample of leaves and twigs were collected in polythene bags. Minor branches were measured for average circumference and average length. Wood samples were collected for bole and branches using a stem borer. The fresh weight and volume of the samples were determined in the field. All the samples were oven dried at 80°C for 36 hours and were measured for dry weight.

Results

Component-wise Biomass for individual trees : In harvest method, the component-wise biomass estimation is done by separating out all the components and measuring their biomass. In the present technique a series of models were generated for estimating biomass of different components of individual trees. The individual tree models are as follows :

Foliage Biomass : The foliage biomass for each sampled major branch was :

$$LBj = D [(\sum_{i=1}^{n} t_i \cdot Cd)/n] \quad ....(1)$$

where,

LBj= foliage biomass for branch 'j' (kg).

D = number of twigs in branch 'j'.

n = number of twigs sampled for branch 'j'.

t_i = fresh weight of leaves in twig 'i' (kg).

Cd = coefficient of dry weighy = td/tf.

td = dry weight of the foliage sample (kg).

tf = fresh weight of the foliage sample (kg).

The foliage biomass of major branches estimated through equation 1, for each species was related to representative branch circumference through :

$$\ln Y = a+b \ln X \quad ....(2)$$

where,

Y = foliage biomass (kg per tree)

X = circumference of branch at the base (cm)

The model was further improved by developing a multivariate relationship of foliage biomass (Y) with circumference (X_1) and branch length (X_2). The relationship was of the form :

$$\ln Y = a+b_1 \ln X_1+b_2 \ln X_2 \quad ....(3)$$

where,

Y = foliage biomass (kg per tree)

X_1 = circumference of branch at the base (cm)

X_2 = length of branch (cm)

The multivariae model exhibited a lower error and a higher coefficient of determination (R^2) than the bivariate model, except for *Mallotus philippensis*.

The foliage biomass for major branches of each individual tree was computed as :

$$Y_{major} = \sum_{i=1}^{n} Y_i \quad .... (4)$$

where,

Y_{major} = total foliage biomass for major branches (kg).

Y_i = foliage biomass for major branch 'i' (kg).

The foliage biomass for minor branches was computed using average branch circumference, average branch length and total number of branches, through the equation :

$$Y_{minor} = D.Y_i \quad .... (5)$$

where,

Y_{minor} = foliage biomass of all the minor branches of the tree (kg)

D = total number of minor branches of the tree

Y_i = average foliage biomass per minor branch (kg) computed using equation 3

Total foliage biomass of complete tree was computed by summing the foliage biomass for major and minor branches.

Twig Biomass : The twig biomass for each sampled major branch was :

$$TBj = D. [(\sum_{i=1}^{n} T_i \cdot Cd)/n] \quad .... (6)$$

where,

TBj = twig biomass for branch 'j' (kg)

D = total number of twigs in branch 'j'

n = number of sampled twigs in branch 'j'

T_i = fresh weight of twig 'i' (kg)

Cd = coefficient of dry weight = td/tf

td = dry weight of twig sample (kg)

tf = fresh weight of twig sample (kg)

The twig biomass for the major branches computed through equation 6 was related with the representative branch circumference through :

$$\ln Y = a + b \ln X \quad \ldots\ldots (7)$$

where,

Y = twig biomass (kg per branch)

X = circumference of branch at the base (cm)

Similar to foliage biomass, the multivariate relationship was developed between twig biomass (Y) and, circumference (X_1) and branch (X_2) :

$$\ln Y = a + b_1 \ln X_1 + b_2 \ln X_2 \quad \ldots\ldots (8)$$

where,

Y = twig biomass (kg per tree)

X_1 and X_2 are same as in equation 3

The multivariated model exhibited a higher R^2 value and lower error in comparison to the bivariate model.

The total twig biomass for major branches for each tree was computed as :

$$Y_{major} = \sum_{i=1}^{n} Y_i \quad \ldots\ldots (9)$$

where,

Y_{major} = total twig biomass for major branches (kg)

Y_i = twig biomass for major branch 'i'

Twig biomass for an average minor branch was computed through equation 8, using average branch circumference and length, which was multiplied with the total number of minor branches to yield total twig biomass for minor branches. Twig biomass for minor and major branches was summed to compute total twig biomass for complete tree.

Bole Biomass : For estimation of bole biomass, bole volume was computed using cbh and length of bole. The bole was considered as a long cone and the volume was measured as :

$$V = \frac{cbh^2 . L}{12 \pi} \quad \ldots\ldots (10)$$

Where,

V = volume of bole (cm^3)

cbh = circumference at breast height (cm)

L = length of bole (cm)

Bole biomass of each individual tree was computed as :

$$\text{Bole biomass (kg)} = V . Cd \quad \ldots\ldots (11)$$

where,

V = volume of bole (cm^3)

Cd = coefficient of dry weight = Bs/Vs

Bs = dry weight for sample wood of bole (kg)

Vs = volume of sample wood of bole (cm^3)

Branch Biomass : Computation procedure for branch biomass was similar to that of bole biomass. The volume of each major branch was estimated by using branch length and branch circumference. Total volume of major branches is given as :

$$V_{major} = \frac{C_i^2 . L_i}{12 \pi} \quad \ldots\ldots (12)$$

where,

V_{major} = total volume of major branches (cm^3)

C_i = circumference of branch 'i' (cm)

L_i = length of branch 'i'

The volume of minor branches was :

$$V_{minor} = D \cdot \frac{C^2 . L}{12 \pi} \quad \text{.................} (13)$$

where,

V_{minor} = total volume of minor brances (cm^3)

D = total number of minor branches in the tree

C = average circumference of minor branches (cm)

L = average length of minor branches (cm)

The total biomass (Y) for all branches was :

$$Y = Cd. [V_{major} + V_{minor}] \quad \text{..........} (14)$$

where,

Y = total branch biomass of the tree (kg)

V_{major} = total volume of major branches (cm^3)

V_{minor} = total volume of minor branches (cm^3)

Cd = coefficient of dry weight = Bs/Bv

Bs = dry weight of sample wood of branch (kg)

Bv = volume of sample wood of branch (cm^3)

Species Biomass Models : The component-wise biomass for different tree species, computed through above mentioned models were used to generate species-wise biomass modes as follows :

$$\ln Y = a + b \ln X \quad \text{...............................} (15)$$

where,

Y = biomass of the tree component (kg per tree)

X = cbh of the tree (cm)

The intercept (a), slope (b), r^2 and Sy. X values for various components of all the analysed species are given in Table 1.

Interspecies Biomass Models : The interspecies biomass models are required for the biomass estimations of occasional or subordinate species for which species specific models are not available. To develop the interspecies biomass models the biomass data of all the analysed species were pooled and related with the cbh through :

$$\ln Y = a + b \ln X \quad \text{...............................} (16)$$

where,

Y = biomass of the tree component (kg)

X = cbh of the tree (cm)

The intercept (a), slope (b), r^2 and Sy. X values for various components are given in Table 2.

Discussion

The relative accuracy of the equations was assessed through the harvest estimates of foliage and twig biomass for a total of 16 trees. Selection of the trees was done randomly from a larger geographical range around Dehra Dun. All the twigs and leaves were lopped from these selected trees and measured for biomass. The biomass data of lopped trees were plotted against the biomass values obtained for corresponding cbh using the models developed in the present study (Figs 1 and 2). Both the data sets were with close agreement with high r^2 value (0.907 for twig biomass and 0.872 for foliage biomass). The 't' value of 0.464 (foliage biomass) and 0.473 (twig biomass) explains that the

Table 1

Allometric Relationship between cbh, X (cm) and biomass of different components Y (kg tree⁻¹) for various species according to lnY=a+b lnX

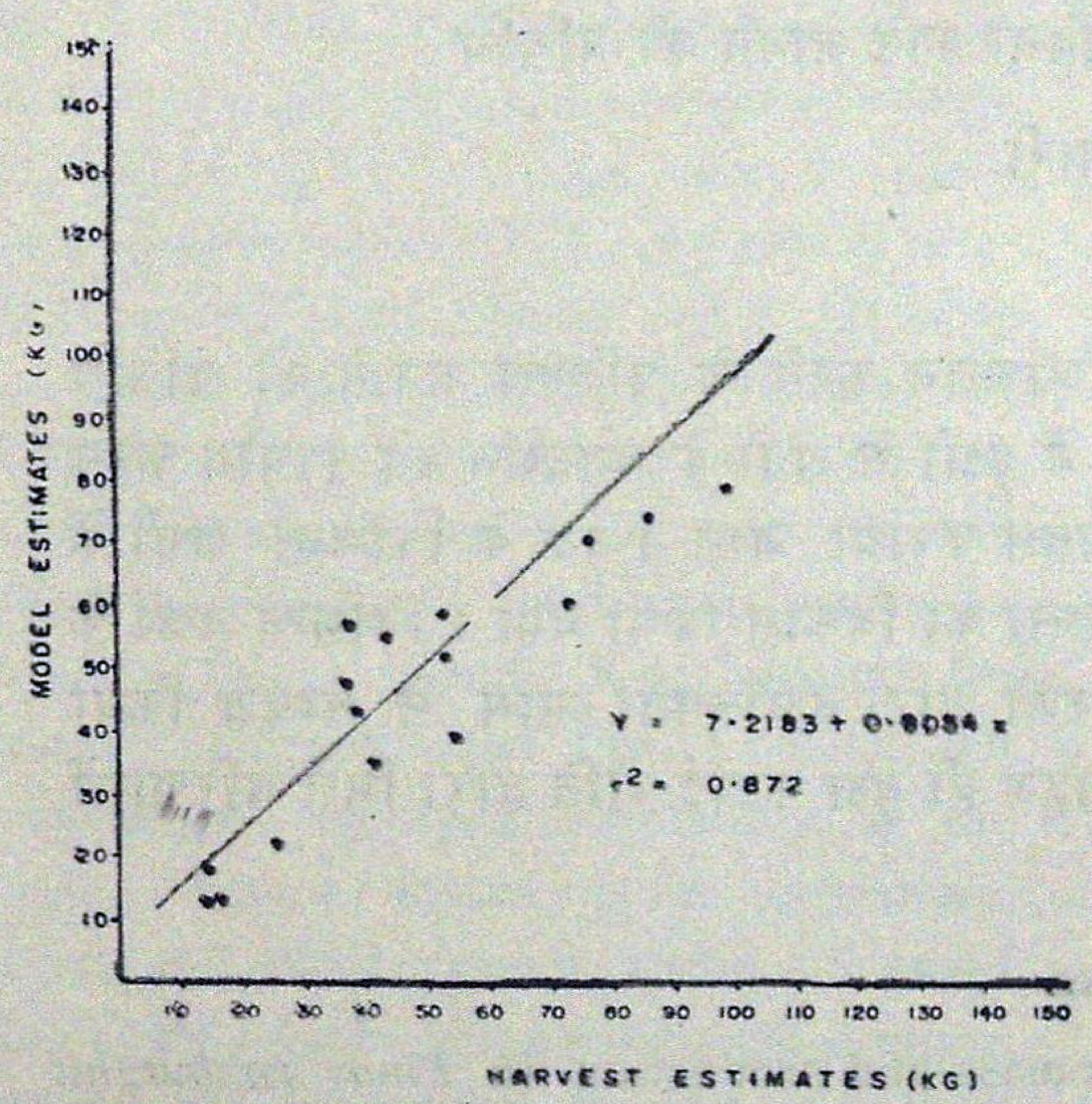
Speces	Intercept (a)	Slope (b)	r^2	Sy. X
S. robusta				
Bole	1.2396	1.1459	0.962	0.051
Branch	0.5898	1.0361	0.953	0.034
Twig	1.2893	0.7209	0.872	0.063
Leaves	0.9131	0.6775	0.795	0.072
Total Above-ground	2.1133	1.0429	0.936	0.071
A. latifolia				
Bole	1.425	1.0241	0.975	0.043
Branch	−0.1301	1.1352	0.899	0.061
Twigs	0.6596	0.8596	0.821	0.071
Leaves	1.8665	0.5125	0.831	0.053
Total Above-ground	2.3399	0.9581	0.913	0.068
T. tomentosa				
Bole	0.6489	1.1065	0.895	0.069
Branch	1.1591	0.7670	0.912	0.052
Twigs	0.9058	0.7536	0.821	0.091
Leaves	−0.0232	0.8260	0.851	0.081
Total Above-ground	1.8161	0.8161	0.933	0.075
T. chebula				
Bole	1.5228	0.8937	0.962	0.072
Branch	1.9849	0.5449	0.916	0.039
Twigs	0.0941	0.6803	0.812	0.057
Leaves	−1.1703	1.0552	0.713	0.055
Total Above-ground	2.7889	0.7198	0.952	0.063
M. philippensis				
Bole	0.6234	0.8912	0.899	0.059
Branch	1.2549	0.6517	0.812	0.066
Twigs	−1.2571	1.0849	0.712	0.053
Leaves	−0.5915	0.8811	0.782	0.084
Total Above-ground	0.3557	1.1551	0.911	0.063

Table 2

Interspecies Relationship between cbh X (cm) and biomass of various tree components Y (kg tree⁻¹) according to $lnY=a+b\ lnX$.

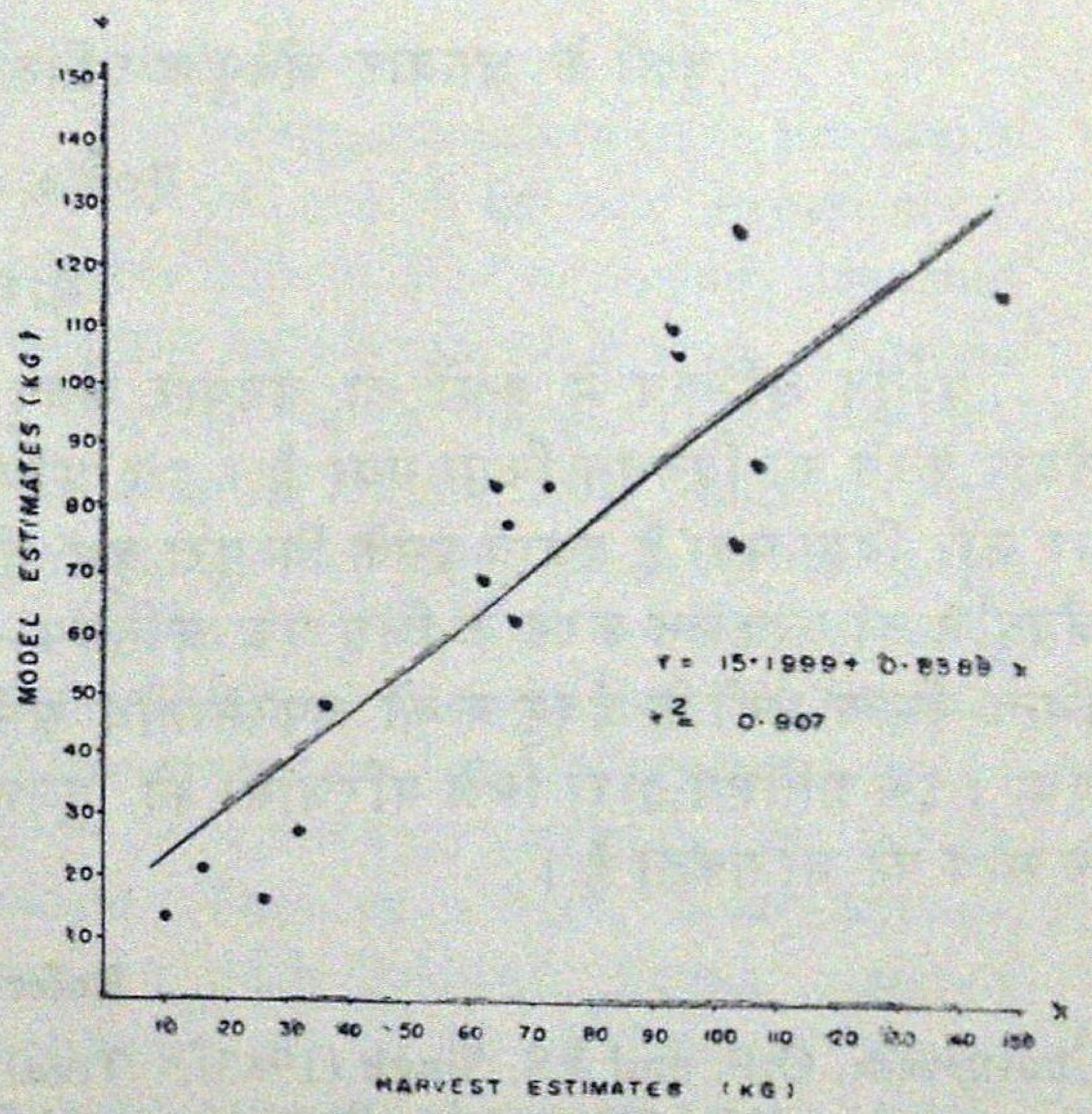
Speces	Intercept (a)	Slope (b)	r^2	Sy. x
Bole	2.1906	1.0193	0.801	0.062
Branch	1.0372	0.8259	0.896	0.096
Twigs	0.7446	0.7852	0.726	0.103
Leaves	0.5024	0.7338	0.695	0.099
Total Above-ground	2.1091	0.9406	0.899	0.082

Fig. 1



Relationship between foliage biomass estimated through harvest (X axis) and through the models generated in the present study (Y axis).

Fig. 2



Relationship between the twig biomass estimated through harvest (X axis) and through the models generated in the present study (Y axis).

differences between the two sets of estimates are insignificant at 95 per cent confidence level.

The method described here offers a wide scope for the forest ecologists to analyse forest biomass within a short period without any significant damage to the tree/ecosystem.

The method can be applied for the site specific to regional biomass studies. The approach for integration of biomass models with remotely sensed data is described in Tiwari and Singh (1984). Similar equations can be developed for damaged trees or for various height strata.

Acknowledgements

Thanks are due to Dr. W.A. Rodgers, FAO Expert, Wildlife Institute of India for stimulating some of the ideas, and to Professor J.S. Singh, Banaras Hindu University, for kindly reviewing the manuscript.

SUMMARY

The present study deals with the generation of the technique for component-wise species biomass estimation models, The technique emphasises the use of sampling of tree components, rather than felling of the complete tree. A series of models was developed for biomass estimation of various tree components. The biomass of different components of various trees individuals was related with the cbh through allometric equations. The results obtained through present models compared well with the estimates obtained through harvest method.

वृक्षों के अगवार जैवपुंज प्रतिरूप–बिना काटे जानने की प्रविधि

ए०के० तिवारी

सारांश

प्रस्तुत अभिपत्र में वृक्षों का अगवार जैत्रपुंज आकलन करने के प्रतिरूप बनाने की प्रविधि तैयार करने का विवेचन किया गया है। इस प्रविधि में वृक्षों के अगों के न्यादर्शन को उपयोग करने पर जोर दिया गया है बजाय इसके कि पूरा वृक्ष ही पातन कराया जाए। वृक्ष के विभिन्न अंगों के जैवपुंज का आकलन करने के लिए एक प्रतिरूप–शृंखला का विकास किया गया। विभिन्न वृक्षों के भिन्न–भिन्न अगों के जैवपुंज को अपरमानीय समीकरणों द्वारा वक्षोच्चता व्यास से सम्बद्ध किया गया। इस प्रतिरूप द्वारा मिले परिणामों की तुलना सहज ही वृक्ष कटाई रीति द्वारा मिले परिणामों के साथ की जा सकती है।

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AGRO-FORESTRY FOR BAY ISLANDS

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Introduction

Bay Islands lie in Bay of Bengal (between 6° to 14° N latitude and 92° to 94° E longitude) with a total geographical area of 8249 km^2. The climate is tropical, warm and humid with temperature ranging between 22°C minimum to 30°C maximum; the mean relative humidy about 79%; and annual rainfall about 3100 mm. Out of about 321 large and small islands, only 35 islands are inhabited and have some kind of agriculture on them which is barely 130 years old and modern techniques of cultivation are yet to take roots in the islands. Rice accounts for about 70% of cultivated area. Coconut and arecanut are important plantations of the islands. Among spices, clove, cinnamon, nutmeg and black pepper grown on small areas in the islands have shown good promise. Agricultural production in the islands is woefully inadequate, cultivation of fodder is not practised, and large livestock population suffers from starvation and malnutrition resulting in very low milk, meat and draft yields. A judicious and sustainable land use pattern, thoughtfully selected and well managed MPTs planted and well blended with agriculture under different agro-forestry systems, are sure to prove beneficial and indispensable for farming community and society as a whole. Based on extensive interviews, survey and experimentation, the following agro-forestry systems/practices have been identified to be suitable and promising for the Bay Islands.

Farming in forests

Most of the settler farmers in the islands were alloted about 4 ha land in post independence period. Half was paddy land and other half hilly forest land after extracting commercial timber trees. These partially felled areas and similar other forest lands are underutilised as they support obnoxious weeds like *Chromolaena odorata*, *Mikania cordata*, *Hyptes capitata* and *Melastemon malabathricum* etc. Impeded regeneration and land deterioration by accelerated erosion are evident. "Farming in forest" is very appropriate for such holdings. Young, vigorous forest trees are to be retained at regular interval. Nutmeg, cinnamon, clove, coffee, etc. may be planted between retained trees. Climbers like black pepper and betel vine may be planted near trees, which will get their support. Fodder grasses such as *Pennisetum purpureum*, *Trepsicum laxum*, *Panicum maximum*, *Pennisetum polystachion*, etc., and fodder legumes such as *Stylosanthes guienensis*, *S. humilis*, *S. hamata*, *Caplopogonium muconoides*, etc. and industrial grasses such as *Cymbopogon flexuosus* may be grown as ground cover crops.

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In an experiment three exotic grasses namely *Trepsicum laxum*, *Panicum maximum* and *Pennisetum purpureum* planted across the slope under partially deforested land without any supplemental irrigation yielded 8.0 to 77.5 t/ha fresh fodder in 3 to 4 cuts over a period of 12 months (Table 1).

Table 1

Performance of three exotic grasses under partial shade.

Grass	Forage yield (t/ha)	Number of cuts
Trepsicum laxum	77.5	4
Panicum maximum	29.5	3
Pennisetum purpureum	8 0	3

Multitier tree crops combination

This system of intensive cropping with existing and new plantations is for arable well drained flat or slopy lands. Plantation crops like *Cocos nucifera* and *Areca catechu* form top storey. *Myristica fragrans*, *Cinnamomum verum*, *Syzygium aromaticum*, *Coffea indica* or *C. arabica* and *Theobroma cacao*, etc. may be raised as middle storey crops. *Manihot esculenta*, *Dioscorea* spp., *Zingiber officinale*, *Curcuma longa* and *Colocassia esculenta* may be grown on plain land as inter-crops. *Carica papaya* and *Musa paradisica* also can be constituents of middle storey on plain land. *Ananas comosus*, vegetables suchas species of *Cucurbita*, *Momordica*, *Luffa*, *Lycopersicon*, *Abelmoschus* etc. and *Vigna sinensis* with adequate manure and fertilizers and leguminous perennial fodders like *Stylosanthes*, *Cajanus cajan* (perennial variety) will give good ground cover and early returns.

Root systems of trees, shrubs and herbaceous plants spread over whole area and draw nutrients and water from different depths. The aerial parts harness most of the sunlight as it is filtered from upper and lower storeys.

In an experiment on young coconut based multitier system on a slopy gravely land *Cinnamomum verum* yield in first year was 202 g and 5.5 kg fresh bark and leaves per plant, respectively which are used as seasoning condiments in curries. The biomass including woody branches was 7.6 kg/plant. Performance of *Pennisetum purpureum* and *Cymbopogon flexuosus* grown in interspaces is summarised in Table 2.

Table 2

Performance of grasses in interspaces of multitier system

Crop	First harvest		Second harvest	
	Plant height (cm)	Yield (t/ha)	Plant height (cm)	Yield (t/ha)
Pennisetum purpureum	182	9.2	128	12.2
Cymbopogon flexuosus	138	8.7	105	6.5

Stylosanthes guianensis was found suitable for similar land as a leguminous cover crop yielding 25 t/ha in a single cut.

Alley farming

This is a system of growing small trees/shrubs in wide rows. The interspace is occupied for seasonal crops. The shrubs are lopped regularly for twigs and foliage and maintained at low height. The returns from hedge row crops are greater than reduction in yield

of main crop due to competition for nutrients, water and sunlight. Due to the rapid growth, ability to stand severe pruning and soil ameliorative properties *Leucaena leucocephala* and *Gliricidia sapium* should be preferred for fodder. Foliage of *Gliricidia* is suitable for green manure and mulch also. *Morus* spp. may also be used for sericulture. *Cajanus cajan* can also be suitable for hedge row crop. Vegetables, pulses and *Ananas comosus* may be grown as inter row crops on mild slopes and deeper soils. Industrial grass *Cymbopogon flexuosus* and forages are suited for marginal lands.

In an experiment on a slopy gravely land *Gliricidia* produced aerial biomass of 6.8 to 8 6 kg/m row length (Table 3) with a foliage to stick ratio of 1:0 82 and 1:0 42 in first and second cut, respectively. The difference was due to profuse branching after first cut

Table 3

Biomass of Gliricidia in hedge rows in two cuts

Associate forage crop	Fresh biomass (kg/m row length)		
	1st cut	2nd cut	Total
Pennisetum purpureum	3.5	3.3	6.8
Panicum maximum	4.2	3.0	7.2
Setaria anceps	4.4	3.2	7.6
Stylosanthes guienensis	4.6	4.0	8.6
Average	4.2	3.4	7.6

Three grasses namely *Pennisetum purpureum*, *Panicum maximum* and *Setaria anceps* grown between hedge rows of *Gliricidia* produced 20.2, 15.5 and 7.0 t/ha, forage biomass, respectively in a single cut.

Pastures and fodder trees in plantations

Livestock population in the islands has increased to 1,78,039 (1982 census) from 38,617 in 1961 (Anon., 1987). This has resulted in an acute shortage of fodder resources. There is a great pressure on fallow-land and limited pastures. Grazing lands are mostly owned by forest department, revenue department, local bodies such as gram panchayats. The average herbage production from these grasslands was estimated to be around 31 q/ha (Singh, 1982). There is an urgent need to make a quantum improvement in these pastures not only by seeding with legumes and other high yielding grasses and by controlled grazing but also by introduction of fodder tree species such as *Trema tomentosa*, *Erythrina variegata*, *Bauhinia*, *Sesbania*, *Leucaena*, *Pithecellobium*, etc. About 10 to 15 fodder trees/ha may be optimum. Old coconut plantations in Great Nicobar and South Andamans are open for grazing. Their fodder yield can be augmented significantly by introduction of pasture grasses and legumes by proper management.

Live fences, hedges and roadside plantations

Fencing is essential for demarcation of boundaries and protection of crops from stray cattle. Barbed wire fencing is very expensive. Contrary to this vegetative live fences and hedges like *Gliricidia sapium*, *Acacia* spp., *Pithecellobium dulcis*, *Agave*, *Carissa carandas*, *Ehretia microphylla*, *Lawsonia alba*, *Clerodendron inerme*, *Duranta repens*, *Sesbania*, *Erythrina*, *Frema*,

Artocarpus, *Bombax ceiba* and *Casuarina equisetifolium*, etc. are suitable for live fences. They also provide fodder and green manure.

Fodder banks on endangered lands

Steep, barren slopes, gullied areas, banks of seasonal nallas/streams etc. are threatened with severe erosion. Their protection and rehabilitation is main concern. Permanent protective cover of fodder trees will transform these endangered lands into valuable fodder banks for cattle when other sources have exhausted.

Multitiered kitchen or home gardens

Small area around homestead in urban and rural areas developed into kitchen garden provide fresh fruits and vegetable.

Trees for low lying areas, beaches and sea shore protection

Swamps, sea shores and sandy beaches are quite common and important part of island ecology. Their conservation is more important than exploitation. All mangroves and other littoral species such as *Pongamia pinnata*, *Thespesia populnea*, *Casuarina equisetifolium*, *Cynometra ramiflora*, etc. are suitable for these areas as they protect land and produce useful fuel and timber or fodder. Successful coconut cultivation on raised beds has also been demonstrated, in some swampy and tidal areas in islands. Protective trailers like *Ipomoea pes-ccpre*, *Vigna marina*, *Canavalia* sp., etc. appear on sandy beaches away from too much interference. Grasses such as *Thourea involuta* also comes successfully in such areas and may be used for fodder.

Silvi-aquaculture in tidal creeks

A network of creeks regularly inundated by brackish tidal waters abound in the islands. Their width and extent varies from a few metres to several hundred metres. Mangrove vegetation often occupies this part of land. Total mangrove area is estimated around 1,15,000 ha (Blasco *et al.*, 1975). The mangroves protect the coastal fringes but are habitat and primary source of food and nutrition for aquatic life like fish, crabs, prawns, turtles, crocodiles and birds. Preservation of mangroves is very essential for conserving the ecosystem. Yet suitable areas preferably behind mangroves can be identified in muddy creeks for aquaculture and cultivation of Nipa Palm (*Nypa fruticans*) as is being successfully done in Bangladesh and elsewhere.

Acknowledgements

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SUMMARY

Agro-forestry is as relevent, meaningful and useful for Bay Islands as it is for any other part of country. Climate, topography, accessibility and cultivation condition of the islands are different than the rest of the country and so are the agro-forestry systems and some of them are quite specific to the islands. Large natural forest area, climate, topography, accessibility, local needs and land holding conditions strongly influence on fitness of agro-forestry systems for the islands. Suitable tree, shrub and herb species for different agro-forestry systems are mentioned.

अण्डमान निकोबार द्वीप समूह में कृषिवानिकी

जे०सी० डागर व विरेन्द्र कुमार

सारांश

बंगाल की खाडी में अण्डमान निकोबार द्वीप समूह जो उष्णकटिबंधीय वनों से ढका है, पर कृषिवानिकी उतनी ही आवश्यक एवं महत्वपूर्ण है जितनी कि देश के किसी अन्य भाग के लिए। द्वीपों की जलवायु, स्थलाकृति, दुर्गमता व लोगों की जरूरतें आदि अलग हैं। अतः सामान्य कृषिवानिकी के अतिरिक्त कुछ ऐसी कृषिवानिकी प्रणालियाँ भी हैं जोकि विशेष इन द्वीपों की परिस्थितियों के अनुरूप उपयोगी हैं। विभिन्न प्रणालियों के लिए उपयुक्त वृक्षों व अन्य पौधों के नाम भी दिए हैं।

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A PRELIMINARY STUDY ON THE GENETIC DIVERGENCE OF *ACACIA NILOTICA* THROUGH SEED PARAMETERS

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Introduction

Acacia nilotica is a multipurpose tree species which has gained considerable importance as a drought tolerant species. It was reported by Shivkumar and Banerjee (1986) that bigger seed size imparts greater seedling vigour and in a subsequent report (Chandra Gupta *et al*., 1991) it was mentioned that the initial vigour was maintained at a later period also. In our previous report (Bagchi and Dobriyal, 1990) it was shown that provenance variation exists and selection at a low key may be effective (where R^2 in terms of provenance contribution can be explained upto 19% only). To circumvent this difficulty, it was planned to find out the genetic divergences among the provenances by means of Mahalanobis's D^2-statistic and subsequent clustering. It was also deemed to be necessary to find out the contribution of independent Y-values towards the divergence, so that, while selection, this particular point can be taken into consideration. After clustering, widely divergent groups may by utilised for hybridisation, if possible to increase the genetic diversity for furtherence in selection or, a superior group may directly be utilised for short-term plantation purposes for an improved seedling vigour and consequently increased growth. With this aim, the present investigation was started with seeds from 42 different seed sources so that they may be assessed quantitatively for genentic divergence.

Materials and methods

The experiment was conducted at the Forest Research Institute, Dehra Dun; using 42 seed source collections from different parts of India. Open-pollinated bulk seeds were collected from various seed sources and has been listed in Table 1. From each provenance collections 40 seeds were selected at random and were measured quantitatively for seed length, seed width and seed thickness in mm with the help of a vernier callipers. The observations on seed parameters were first analysed for the significance test of V-statistic. The V-statistic being significant further analysis were taken up. The mean-squares and mean-products were estimated for between-group and within-group components by one-way analysis of variance/covariance and the significance tested at provenance level. A variance-covariance matrix was formed from the above and subjected to pivotal condensation to obtain the linear functions for transformation of character mean values (X) to a set of independent variables (uncorrelated mean) values (Y). The difference between any two mean values for each pair of provenance was squared and added to give

Table 1

Seed sources of Acacia nilotica

Prov.	Seed sources	State
1	Mangalpur Forest nursery, Karnal.	Haryana
2	Binjhol Forest nursery, Panipat.	Haryana
3	Social For. Range, Dayalbagh block, Ambala.	Haryana
4	Rohtak Range Forest Office. Rohtak.	Haryana
5	Ramgarh block, Panchkula Range, Ambala.	Haryana
6	Kakroi Vill., Sonipat Range, Sonipat,	Haryana
7	Balsamund block, Social Forestry, Hissar.	Haryana
8	Canal block, Social Forestry, Faridabad.	Haryana
9	Mehm Road block, Social Forestry, Bhiwani.	Haryana
10	Behr block, Jind Range, Jind.	Haryana
11	Survey No. 15, Kankanhally Village, Ayanur Range Shimoga,	Karnataka
12	Seed grass farm nursery, Kathipura road, Jaipur.	Rajasthan
13	Brindavan block, Mathura.	Uttar Pradesh
14	Guntur.	Andhra Pradesh
15	Ranaghat.	West Bengal
16	Cent. Arid. Zone Res. Inst., Jodhpur.	Rajasthan
17	Rajnagar Range, Birbhum.	West Bengal
18	Mile post 90, Bhoginipur Canal, Etawah.	Uttar Pradesh
19	Extension Div. Office, Rajkot.	Gujrat
20	Krishnanagar.	West Bengal
21	Social For. Div , Sultanpur Range, Kota.	Rajasthan
22	Divisional Forest Office, Udaipur North.	Rajasthan
23	Kota For. Div., Kota.	Rajasthan
24	Divisional Forest Office, Udaipur South.	Rajasthan
25	Ajmer For. Div., Ajmer.	Rajasthan
26	Pushkar, Ajmer.	Rajasthan
27	Pali For. Div., Pali.	Rajasthan
28	Jamwa Ramgarh, Jaipur West.	Rajasthan
29	Padampura, Sawai Madhopur, Jaipur.	Rajasthan
30	Manpur nursery, Abu Road, Datawari.	Rajasthan
31	Bagad, ka Triha, Alwar For. Div., Alwar.	Rajasthan
32	Todabhim, Jaipur.	Rajasthan
33	Ramgarh, Jaipur.	Rajasthan
34	Padampura, Sawai Madhopur.	Rajasthan
35	Ghana Bird Sanctuary, Central Nursery, Bharatpur.	Rajasthan
36	Naya Bas block, Churu.	Rajasthan
37	Govindpura, Seekar.	Rajasthan
38	Raiser block, Jaipur.	Rajasthan
39	Kathputali block, Jaipur.	Rajasthan
40	Barora Easwal block, Udaipur.	Rajasthan
41	Dholpur block, Agra Road, Dholpur.	Rajasthan
42	Agahpur block, Agahpur, Bharatpur.	Rajasthan

the D^2 values. Cumulative D^2 values in all possible combination of provenance pairs were estimated separately for each Y-characteristic. To find out the clustering pattern, the highest value at the first row (of the D^2 values arranged in an increasing order) was used as a starter, and gradually provenances of lower to higher values were added on the basis that the average D^2 values due to addition of a new one must be smaller than when any other provenance was added. When a sudden jump to a higher value was noticed, aggregation in current cluster was stopped and a new cluster or group in the same fashion was begun. On completion of clustering, the intra- and inter-cluster relationships were studied and the mutual relationships between clusters and their distances were represented. A similar technique was used by others following Rao (1952). Help from Sing and Chowdhary (1979) was also taken for the present study.

Results and Discussion

Table 2 gives the mean values of three characters for all the provenances. Character-wise analysis of variance generated between-provenance and within-provenance mean squares as given in Table 3. It was observed that all the five characters were significantly different. With the help of the estimated variances and covariances, a 3×3 variance-covariance matrix was formed (Table 4). The matrix was then subjected to pivotal condensation to get the transformation functions and transformation matrix (Table 5). Uncorrelated Y-values (Table 6) were than obtained from the mean character values using these transformation functions. D^2 values were obtained by summing up the squared differences of each mean pair. By clustering technique these 42 seed sources were grouped into 2 clusters A and B (Tables 7 and 8). Out of which group A formed the largest cluster containing 34 seed sources and group B the rest. It may be seen from the Table 7, that seed sources from different locations were clustered together to form the group A. This signifies that all seed sources from a single zone may not necessarily form a single cluster and the pattern of genetic nearness is not dependent on the geographical nearness. This generally happens when seed sources are of different genetic make up and are distantly related. Similar results were obtained in agricultural crops when selections from the same cross did not form a single cluster due to wider relations between the two parents (Murthy and Arunachalam, 1966; Murthy and Pavate, 1962; Singh and Gupta, 1968). The larger group size of A is probably due to a large intra-cluster distance which encompassed the maximum number of seed sources (Table 9 and 10). While the group A showed higher intra-cluster distance, group B the lower. The intra-cluster distance between A and B was found to be quite high.

It was observed from the Table 11 of the contribution of Y-values towards divergence that the Y3 contributes more than 52%, Y2 contributed more than 33% and the Y1 more than 14%. It may therefore be said that the divergence is maximally decided by the contributions of Y3 and Y2.

The group mean values presented in Table 12, shows that the group A is best between the two. It had the highest values for all the three characters. As the distance between the two groups is quite high, hybridi-

sation between the selected plant types from two groups are expected to yield greater genetic diversity which may be suitable for further selection. The superiority of group A enables us to utilize it for general plantation purposes for probable sustained vigour and growth.

Table 2

Original interrelated mean data "X" of provenances

Prov. No.	Seed length (X1)	Seed width (X2)	Seed thickness (X3)	Prov. No.	Seed length (X1)	Seed w dth (X2)	Seed thickness (X3)
1	7.9750	7.2125	4.2000	22	8.1375	6.9250	4.3250
2	8.0500	7.3125	4.2750	23	7.9125	6.7375	3.9125
3	8.1150	7.1375	3.9000	24	8.4375	6.8875	3.9125
4	8.1625	6.9750	3.9750	25	8.2250	6.8750	4.4575
5	7.9500	7.2500	4.4000	26	8.0000	6.8625	3.9750
6	8.1850	7.1875	4.3000	27	8.2875	6.7250	4.4000
7	8.1500	7.2250	3.9875	28	8.2000	7.0250	4.1250
8	7.9625	6.8375	3 9500	29	8.0750	6.8500	4.0625
9	8.1875	7.0875	3.7250	30	8.1900	6.7750	4.2875
10	8.3125	7.4500	4.1375	31	8.2375	7.0000	3.7750
11	8.1875	6.8750	4.2750	32	8.0875	6.7500	4.0750
12	8.5250	6 9000	4.0625	33	8.0000	6.8000	4.0500
13	7.8750	6.5375	4.1500	34	8.3000	6.9875	4.1750
14	8.1625	6.9000	4.0875	35	7.4375	6.1250	2.9875
15	8.6000	7.4000	4.3000	36	7.5500	5.9625	3.5375
16	7.9000	6.6125	4.3125	37	7.5625	5.9000	3.5875
17	8.4375	7.0000	4.0250	38	7.5625	5.9875	3.2750
18	7.8250	6.8500	3.9625	39	7.5125	6.4750	3.3750
19	8.2625	6.6375	4.4875	40	7.6125	6.1375	3.3875
20	7.5125	6.2750	4.3500	41	7.7625	6.3500	3.2125
21	7.9500	6.6375	3.9375	42	7.5250	6.1250	3.4250

Table 3

Mean-squares of three characters.

Sources of vriation	df	Seed length	Seed width	Seed thickness
Bn group	41	3.541***	6.298***	5.319***
Wn group	1638	0.3905	0.2684	0.1519

Table 4

Variance-covariance matrix (within group).

0.423	0.158	0.051
0.158	0.268	0.038
0.051	0.038	0.152

Cluster analysis based on (within groups) matrix

Table 5

Transformation Functions 'Y'

	X1	X2	X3
Y1 :	1.0000 (1.5367)		
Y2 :	—0.3742 (—0.8182)	1.0000 (2.1867)	
Y3 :	—0.0887 (—0 2338)	—0.0879 (—0 2317)	1.0000 (2.6350)

1. Standard deviations of transformation functions 0 650763 0.457313 0.379500
2. Values in parenthesis are the values of transformation matrix to convert 'X' values to 'Y'.

Table 6

Transformed uncorrelated mean data 'Y'

Prov. No.	Y1	Y2	Y3	Prov. No.	Y1	Y2	Y3
1	12.2548	9.2460	7.5322	23	12.1588	8.2584	6.8993
2	12.3701	9.4033	7.6891	24	12.9655	8.1569	6.7418
3	12.4700	8.9674	6.7263	25	12.6390	8.3034	8.2305
4	12.5430	8.5732	6.9505	26	12.2933	8.4602	7.0145
5	12.2164	9.3484	8.0563	27	12.7350	7.9243	8.0991
6	12.5775	9.0195	7.7524	28	12 6006	8.6519	7.3254
7	12.5238	9.1301	6.9284	29	12.4085	8.3715	7.2305
8	12.2356	8.4362	6.9632	30	12.5852	8 1134	7.8138
9	12.5814	8.7988	6.2598	31	12.6582	8.5665	6.4002
10	12.7735	9 4892	7.2336	32	12.4277	8.1426	7.2836
11	12.5814	8.3341	7.7583	33	12.2933	8.3235	7.2266
12	13.1000	8.1126	7.1137	34	12.7542	8.4880	7.4425
13	12.1012	7.8518	7.5802	35	11.4289	7.3078	4.7148
14	12.5430	8.4092	7.2643	36	11.6018	6.8604	6.1754
15	13 2152	9.1446	7.6062	37	11.6210	6.7135	6.3187
16	12.1396	7.9953	7.9851	38	11.6210	6.9048	5.4750
17	12.9655	8.4029	7.0122	39	11.5441	8.0117	5.6372
18	12.0243	8.5760	7.0254	40	11.6978	7.1919	5.7250
19	12.6966	7.7534	8.3558	41	11 9283	7.5338	5.1796
20	11.5441	7.5744	8.2527	42	11.5633	7.2362	5.8471
21	12.2164	8.0091	6.9795				
22	12.5045	8.4843	7.8902	Total	517.7034	346 5802	295.6958

Table 7

Clustering of provenances

Cluster	Provenance added	Added terms	Increase in D^2	Av. incr in D^2	Total terms	Total D^2	Average D^2
1	2	3	4	5	6	7	8
A	8						
	26	1	0.0007	0.0007	1	0.0007	0.0007
	23	2	0.0114	0.0057	3	0.0120	0.0040
	33	3	0.0279	0.0093	6	0.0399	0.0066
	29	4	0.0374	0.0093	10	0.0772	0.0077
	18	5	0.0697	0.0139	15	0.1469	0.0098

Contd...

1	2	3	4	5	6	7	8
	4	6	0.1055	0.0176	21	0.2524	0.0120
	14	7	0.1188	0.0170	28	0.3712	0.0133
	32	8	0.1572	0.0197	36	0.5284	0.0147
	21	9	0.2152	0.0239	45	0.7435	0.0165
	28	10	0.3022	0.0302	55	1.0457	0.0190
	34	11	0.4204	0.0382	66	1.4661	0.0222
	17	12	0.5587	0.0466	78	2.0248	0.0260
	11	13	0.7163	0.0551	91	2.7411	0.0301
	30	14	0.9155	0.0654	105	3.6566	0.0348
	22	15	0.9578	0.0639	120	4.6144	0.0385
	13	16	1.0894	0.0681	136	5.7038	0.0419
	12	17	1.2451	0.0732	153	6.9489	0.0454
	24	18	1.3895	0.0772	171	8.3384	0.0488
	3	19	1.7230	0.0907	190	10.0614	0.0530
	7	20	1.8645	0.0932	210	11.9259	0.0568
	31	21	2.0291	0.0966	231	13.9550	0.0604
	6	22	2.2561	0.1026	253	16.2111	0.0641
	1	23	2.6568	0.1155	276	18.8679	0.0684
	16	24	3.0760	0.1282	300	21.9439	0.0731
	25	25	3.4765	0.1391	325	25.4204	0.0782
	27	26	3.6071	0.1387	351	29.0275	0.0827
	2	27	4.1357	0.1532	378	33.1632	0.0877
	15	28	4.2349	0.1512	406	37.3981	0.0921
	10	29	4.4771	0.1544	435	41.8752	0.0963
	9	30	5.0468	0.1682	465	46.9220	0.1009
	5	31	5.7557	0.1857	496	52.6777	0.1062
	19	32	7.2460	0.2264	528	59.9236	0.1135
	20	33	10.6459	0.3226	561	70.5696	0.1258
B	40						
	42	1	0.0035	0.0035	1	0.0035	0.0035
	38	2	0.0402	0.0201	3	0.0437	0.0146
	36	3	0.1065	0.0355	6	0.1503	0.0250
	37	4	0.1877	0.0469	10	0.3380	0.0338
	41	5	0.5329	0.1066	15	0.8709	0.0581
	39	6	0.6967	0.1161	21	1.5676	0.0746
	35	7	1.0391	0.1484	28	2.6067	0.0931

Note : The above are 0.1 times of actual values, maximum av. increase permitted in D^2 on adding a new provenance = 3.2260.

Table 8

Clusterwise List of Strains

Cluster	Strains									
A	1	2	3	4	5	6	7	8	9	10
	11	12	13	14	15	16	17	18	19	20
	21	22	23	24	25	26	27	28	29	30
	31	32	33	34						
B	35	36	37	38	39	40	41	42		

Table 9

Intra-and Inter-cluster average D2

Cluster	A	B
A	1.258	6.409
B	6.409	0.931

Table 10

Intra-and Inter-cluster Average Distances

Cluster	A	B
A	1.122	2.532
B	2.532	0.965

Table 11

Contribution to Divergence by Transformed Characters

Character → contribution	X1	X2	X3	Total
Number of times in first rank	118	306	437	861
Percentage of first rank	13.70	35.54	50.76	100.00
Percentage of distance relation	14.54	33.33	52.13	100.00

Table 12

Group mean of characters.

Cluster	Strains	X1	X2	X3
A	34	8.129	6.926	4.127
B	8	7.566	6.133	3.348

SUMMARY

Reports on *Acacia nilotica* show that bigger seeds produce vigorous seedlings and the vigour is maintained throughout its growth period. In search of bigger seeds and of contribution of individual characteristics towards divergence, genetic divergence studies were conducted with the help of Mahalanobis's generalised D^2-statistic among 42 provenances of *Acacia nilotica*. Each provenance was represented by 40 random samples of seeds, from each of which seed length, seed width and seed thickness were measured in mm. The estimated V-statistic was found to be significant (1773.753) at 0.001% level of probability with 123 degrees of freedom when tested as chi-square. Cluster analysis resulted in two groups, viz, A and B Of which A was the bigger group having 34 provenances and B the smaller with 8 provenances. The divergence (inter-cluster distance) between the two groups (2.532) was found to be quite high. The inter-cluster distance was higher in A then B. The characteristic Y3 contributed towards the maximum divergence and is more than 52% whereas Y2 (33.33%) and Y1 (14.54%) were serially next. The group B contain the provenances belonging to Rajasthan only, whereas the group A included

samples from all other States. It may therefore be said that the clustering pattern is not based on geographic nearness but on genetic nearness and the clustering pattern is independent of geographical distribution. It may be concluded from the study that group A is best having higher group mean values for all the three characteristics. The higher inter-cluster distance in group A indicates higher variability within the group and it is quite likely that extreme individuals from group A may help in selection. Hybridisation between widely divergent groups may also help producing greater genetic diversity which may be utilised for further selection.

अकेसिया नीलोटिका की आनुवांशिकीय विभिन्नताओं का बीज परिमापों के माध्यम से किया गया प्रारम्भिक अध्ययन

एस०के० बाग्ची

सारांश

अकेसिया नीलोटिका के विवरण बताते हैं कि इसके बड़े बीजों से ओजस्वी पौधे उगते हैं और बढ़वार की पूरी अवधि में वे अपनी ओजस्विता बनाए रखते हैं। बड़े बीजों तथा विभिन्नता लाने वाले लक्षणों की खोज करने के लिए अकेसिया नीलोटिका के विभिन्न स्थानभेदों का महलानवीस की सार्वीकृत डी 2–सांख्यिकीय रीति से आनुवांशिकीय अध्ययन किया गया। प्रत्येक स्थानभेद के बीजों के समसभाविक 40 नमूने लिए गए जिनमें से प्रत्येक बीज की लम्बाई, चौड़ाई और मोटाई मिमी० में मापी गई। अनुमानित वी–सांख्यिकीय 0.C01% सभावना स्तर पर सार्थक पाया गया जिसकी ची–वर्ग में परीक्षा करने पर स्वतन्त्रता अंश 123 पाया गया। समूह विश्लेषण में दो वर्ग ए और बी बने। इनमें ए बड़ा रहा जिसमें 34 स्थानभेद आए, बी छोटा रहा जिसमें 8 स्थानभेद आए। दोनों वर्गों की विभिन्नता (समूहों के बीच की दूरी) (2.532) काफी सार्थक पाई गई। बी की अपेक्षा ए में समूह के बीच का ही अन्तर अधिक रहा। वाई 3 लक्षण का योगदान अधिकतम विभिन्नता में 52% से भी अधिक रहा जबकि वाई 2 (33.3%) और वाई 3 (14.54%) क्रम से उसके बाद आए। बी वर्ग में केवल राजस्थान के स्थानभेद रहे जबकि वर्ग ए में दूसरे सभी राज्यों के नमूने आए। इसलिए कहा जा सकता है कि समूह बनने की रूप सज्जा भौगोलिक निकटता के आधार पर नहीं बल्कि आनुवांशिक निकटता के आधार पर है और समूह बनने की सज्जा भौगोलिक वितरण से स्वतन्त्र है। निष्कर्ष इस अध्ययन का यह माना जा सकता है कि वर्ग ए उत्तम है जिसकी माध्य अर्हांसे सभी तीनों लक्षणों के लिए उच्चतर है। समूह के अन्दर का अन्तर वर्ग के अन्दर अधिक विभिन्नीयता का सकेतक है और बहुत सभव है कि वर्ग ए के सुदूरस्थ वृक्ष के चुनाव में सहायक बन सके। परस्पर बहुत विभिन्न वर्गों में सकरण भी और अधिक आनुवांशिक विभिन्नता उत्पन्न करने में सहायक बन सकता है जिसका उपयोग उसके बाद वाले अगले चुनाव में किया जा सकता है।

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EFFECT OF DIFFERENT FACTORS ON THE SUCCESS OF TENDER SHOOT CLEFT GRAFTING IN CHILGOZA (*PINUS GERARDIANA* WALL)

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Introduction

Chilgoza (*Pinus gerardiana*) is an important forest cash crop, predominating in Sutlej Valley of tribal belt of Himachal Pradesh. Due to ruthless and excessive harvest of cones for quantum jump of price on one hand and reckless felling of trees for fuel and timber on other, it has ceased its natural regeneration on the ground. Since it is one of the most valuable trees not only in this region but the country as a whole its genetic improvement for better yield and quality of nut (seed) have been initiated by selecting the provenances and plus trees. The vegetative propagation is the first and foremost step in tree improvement programmes and attempts were made only by a few workers : Chandra and Mahindru (1976) and Singh (1989) in this regard. However, the trial on its vegetative propagation were made by Department of Forests, H.P. but there is no published record of it in any Scientific journal specially on the factors effecting the success of grafting. Tender-shoot-cleft-grafting has given the best successful result which is governed by four factors : (i) age of root-stock, (ii) age of clone (plus tree), (iii) age of scion material, and (iv) time of grafting.

The factors which affect the success of clonal propagation were studied by several workers on horticultural plants: Alley (1961), Stevenson (1948), Singh and Singh (1961), Mukherjee and Majumdar (1964), and Mukherjee *et al.* (1966 and 1967). However, there is no work on indigenous species of pine except that of Kedharnath and Dhaundiyal (1963). The present communication deals with secret of success on the vegetative propagation of chilgoza pine.

Materials and Methods

Attempts were made on vegetative propagation (Tender-shoot-cleft-grafting) of chilgoza at Regional Horticultural Research Station, Sharbo, located at 2200 m elevation in dry temperate zone of North-Western Himalaya. The study has been carried out with respect to the importance of the following factors in the month of February and March 1989.

Age of root stock : The seedlings of two age groups, two and half years and four and half years old attaining the height of 15-20 cm and 35-50 cm respectively were used as root-stock in tender-shoot-cleft-grafting (Fig. 1 and 2).

Age of clone (Plus tree) : Two clones of

Fig. 1

Tender-shoot-cleft-grafting
($2\frac{1}{2}$-3 years old seedlings)

Fig. 2

Tender-shoot-cleft-grafting
($4\frac{1}{2}$-5 years old seedlings)

different age groups having the height 22 m and 10 m and girth 150 cm and 80 cm respectively were selected for the collection of scion. As regards the flowering and fruiting, both the trees were good cone bearer. The scion material was collected and 25 grafts of each were made.

Age of scion : One year, two years and three years old scion was collected from the leading shoots and 25 grafts of each were made.

Time of grafting : The aforesaid grafting was carried out in mid of February and March 1989.

Results and Discussion

The results of the study are presented in Table 1 and 2 of respective factor. The important points brought out in this paper are that all four factors are vital for successful achievement. The most effective factor is the time of grafting (February), followed by the age of clone (medium sized tree not over matured), the age of root-stock (2 and half years), and the age of scion material (2 years old).

Kedharnath and Dhaundiyal (1963) had also established that two-years old branch of *Pinus roxburghii* and *P. caribaea* gave the best result in rooting.

Since the selection criteria of trait is fruit (nut) and not the timber, therefore

Table 1

Type of grafting	February 16 (1989)			March 16 (1989)		
	No. of grafts prepared	No. of grafts intake (patch up)	No. of grafts survived	No. of grafts prepared	No. of grafts intake (patch up)	No. of grafts survived
Tender-shoot-cleft	25	22	17	25	14	—
Cleft	25	15	4	25	7	—
Side	25	5	—	25	—	—
Veneer	25	7	—	25	—	—

Table 2

Performance of tender-shoot-cleft-grafting

	February				March			
	No. of grafts made	Grafts patched up	Grafts survived	Percentage of survival	No. of grafts made	Grafts patched up	Grafts survived	Percentage of survival
Age of clone :								
1A—Medium sized tree	25	21	18	72	25	12	1	5
1B—Mature & over mature tree	25	10	2	10	25	3	nil	—
Age of seedlings (root-stock) :								
2A—2½ years	25	22	17	70	25	14	2	10
2B—4½ years	25	7	2	10	25	8	nil	—
Age of scion :								
3A. 1 year	25	8	2	10	25	4	nil	—
3B. 2 years	25	24	19	75	25	12	1	5
3C. 3 years	25	5	nil	—	25	nil	nil	—

medium-sized good cone bearer trees should be marked for the selection clone (plus tree) since mature and over-mature tree do not give the desired results. Same time, the age of scion plays a key role in propagation and that is why the worker must be well acquainted in identifying the age of scion material.

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SUMMARY

Four factors, namely time of grafting, age of clone, age of root-stock, and age of scion, have direct bearing on the success of tender-shoot-cleft-grafting on Chilgoza. February is the best period which gives 65-70% success, followed by medium-size of tree (less than one metre girth), two and half years old root-stock and two years old scion.

चिलोगोजा (पाइनस गेरार्डियाना वालिश) की कोमल प्ररोह दीर्ण कलम लगाने की सफलता पर विभिन्न कारकों का प्रभाव

एन०जी० सिंह

सारांश

चिलगोजा की कोमल प्ररोह दीर्ण कलम लगाने की सफलता पर चार कारकों अर्थात् कलम लगाने का समय, कृन्तक की उम्र, मूल समूह की उम्र और उपरोपिका की उम्र का सीधा प्रभाव पड़ता है। इसे लगाने का सबसे अच्छा मौसम फरवरी है जिसमें लगाने पर 65-70% सफलता मिल जाती है जिसके बाद प्रभावकारिता में क्रमश: वृक्ष का मध्यम आकार (गौलाई एक मीटर से कम होना), जड़-समूह ढाई वर्ष उम्र का होना और उपरोपिका दो वर्ष की होना आते हैं।

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SEED SCARIFICATION REQUIREMENT IN *INDIGOFERA GERARDIANA*, WALL.

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Introduction

Indigofera gerardiana Wall. is a common shrub of North-West Himalayas and eastern skirts of the Suliman range ascending from 1650-2635 m (Collett, 1902; Gamble, 1922). This shrub is often gregarious on dry grassy slopes (Gamble, 1922) and in scrub forests specially in old clearings (Anon, 1945). It is also found commonly associated with *Quercus leucotrichophora*, *Pinus wallichiana* and *Picea smithiana*. It affords a good plant cover to many important conifers such as *Pinus roxburghii*, *P. wallichiana*, *Cedrus deodara* and *Picea smithiana* (Troup, 1921; Gamble, 1922). Its twigs are used for basket work and also form part of twig bridges of the Western Himalayas (Gamble, 1922). This species is also reported to yield a fodder of medium value (Gamble, 1922; Laurie, 1945).

The genus *Indigofera* possess hard seed coat (Justice and Louis, 1979) and shows impermeability to water (Brown and Booysen, 1969). Various seed pretreatment methods have been found to be useful in breaking impermeability to water in many species (Alvarez and Bangaloyos, 1977; Heydecker and Coolbeeur, 1977). Under laboratory conditions, the seeds of this species without any scarification gave only 8-12% germination in 30 days. Therefore, it was thought desirable to study the seed scarification requirement of this species for nursery as well as field sowings.

Material and Methods

The pods of *Indigofera gerardiana* were collected from Fairlawn locality situated in the out-skirts of Shimla town during November, 1988. The pods were sun dried for about a week till pods ruptured and seed extraction was done thereafter. The seeds were scarified with conc. sulphuric acid for different durations and then washed thoroughly in running tap water. 100 seeds with four replications were put on a moist filter paper in petridishes kept at 25°C in germination chamber. The emergence of radicle was taken as a criterion of seed germination and germination was counted daily till 30 days. The germination values were calculated by following the method of Czabator (1962). Data on germination percentage and germination values were statistically analysed.

Results and Discussion

Germination percentages and germination values as affected by different durations of scarification are summarized in Table 1.

The results of germination percentage showed that acid scarification upto 90 minutes enhanced germination and tended to reduce it thereafter on further acid treatment. 90 minutes treatment showed maximum germination of 70% whereas control gave only 11.75% germination. A substantial drop in

Table 1

Scarification time (minutes)	Germination percentage	Germination value
Control	11.75	0.50
15	19.50	1.00
30	29.75	2.86
45	37.50	6.05
60	43.50	6.30
75	61.25	13.61
90	70.00	19.94
105	34.25	3.93
120	38.50	4.38
C.D. value at 1% level	6.19	3.15

germination was noticed beyond 90 minutes. Statistical analysis of germination data after are sine transformation showed that all the treatments differed significantly with control as well as with each other, except, 45 and 60 minutes as well as 105 and 120 minutes treatments which were statistically non-significant. Germination values also showed the trend of germination percentage. Statistical analysis of germination values showed that 75 and 90 minutes treatments were significantly different from all the remaining treatments.

The results thus showed that in order to ensure optimum germination as well as to speed up germination, seeds of *Indigofera gerardiana* should be acid scarified for 90 minutes. These results are in agreement with the findings of Whiteman and Mendra (1982) who found that germination of *Brachiaria decumbens* (Signal grass) was improved by acid scarification for 20 minutes. Roy *et al.* (1984) reported that sulphuric acid treatment of *Dichrostachys cinerea* seeds for 25 minutes resulted in optimum germination. Farmer *et al.* (1982) also reported that acid scarification of *Rhus glabra* and *Rhus coppalina* for 120-360 minutes and 10-30 minutes, respectively resulted in optimum germination.

SUMMARY

In this paper the results of experiment conducted on seeds of *Indigofera gerardiana* for optimum germination through acid scarification have been described in detail.

इंडिगोफेरा गेरार्डियाना वालि० के बीजों को खुरचने की आवश्यकताएं

सरजन भगत, वीरेन्द्र सिंह व ओमबीर सिंह

सारांश

इस अभिपत्र में उस सम्परिक्षण के परिणाम पूरे विस्तार सहित दिए गए हैं जो इष्टतम अकुरण प्राप्त करने के लिए इंडिगोफेरा गेरार्डियाना के बीजों को अम्ल द्वारा खुरचने का किया गया था।

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PRELIMINARY STUDIES ON THE SEASONAL OCCURRENCE OF INSECT PESTS ON SOAP-NUT (*SAPINDUS* SP.)

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Introduction

The soap-nut tree, *Sapindus* sp. (Sapindaceae) is grown all over the world for its fruits or nuts. The pericarp of these fruits gives copious lather with water which is being largely used as a substitute for soaps in washing woolen and silk clothes and mostly by Indian woman for head bath. The hard yellow wood is used for manufacturing wooden articles like combs etc.

Sapindus muskorossi (L.); *S. trifoliatus* Hiern and *S. saponaria* (L.) are cultivated in warmer parts of America and Asia (Chopra and Reddy, 1954). In India *S. muskorossi* (L.) is found as a wild plant in Dehra Dun and Himalayas at an altitude of 4000 feet (Mathur, 1974). *S. laurifolius* Vahl., *S emarginatus* Vahl. are the most common soap-nut trees of South India. These are grown as a border plants in orchards of Andhra Pradesh especially in Srikakulam, Vizianagaram, Guntur and Prakasam Districts. In recent times, the enterprizing farming community is coming forward to raise the soap-nut gardens because of attractive net profits due to the high market value for its fruits. Since soap-nut was considered as a neglected crop, proper attention was not bestowed to study systematically about the infestation caused by different insect pests.

Green (1919) recorded a coccid *Fiorinia sapindi* damaging *S. trifoliatus. Myzocallis insularis* a new aphid was reported from Formosa on *S. muskorossi* (Takahashi, 1927).

The present studies were undertaken around Bapatla with a view to observe the seasonal occurrence and extent of damage caused by the insect pests on this crop.

Materials and Methods

The seasonal occurrence, nature of damage and intensity of infestation by insect pests on soap-nut were studied by conducting weekly surveys around Bapatla during 1987 and 1988.

Panicles and leaves infested with insect pests were brought to the laboratory and reared. These insects were indentified by CAB, International Institute of Entomology, London.

The intensity of infestation caused by each insect was recorded by counting the number of panicles/leaves affected in each branch.

Results and Discussion

The nature of damage, seasonal occurrence and intensity of infestation by different insect pests of soap-nut is presented in Table 1.

Table 1

Seasonal occurrence, nuture of damage and intensity of certain insect pests on soap-nut around Bapatla

Common name	Scientific name and family	Damage	Seasonal occurrence	Intensity of occurrence	Remark
1	2	3	4	5	6
1. *Flower feeders*:					
Soap-nut moth	*Serrodes inara* Cram Noctuidae	Larvae feed voraciously during nights on flower panicles and completely eat away the flowers leaving only the stalks	Sept-Feb	40-60%	A regular occurring pest
Soap-nut semilooper	*Tinolius eburneigutta* Walk. Noctuidae	Larvae feed on flower buds	Oct-Feb	5%	Minor incidence
Blossom webber	*Cydia* sp. Tortricidae	Larvae bores into flowers, flower buds and tender nuts. Webs them and feed. It also feeds in the axils of the twigs when new flush arises	Oct-April	80%	Overlapping generations and a regular pest
Soap-nut tree bug	*Tessaratoma javanica* Thumb. Pentatomidae	Nymphs and adults suck sap from stalks of the panicle and tender shoots	Sept-May	60-80%	A regular occurring pest
Lygaeid bug	*Geocoris lituratus* (Fieber) Lygaeidae	Nymphs and adults suck sap from green flower buds and stalks of the flower	Sept-April	5%	Minor incidence
Green bug	*Melicharia guadrats* Kirby. Fulgoridae	Bugs suck sap from tender shoots and stalks of the panicle	Oct-April	5%	-do-

Contd ..

1	2	3	4	5	6
Mealy bugs	*Ferrisia virgata* Cakrell. Coccidae	Suck the sap from the panicles. Sooty mould follows	Oct-Feb	5%	Minor incidence
Weevils	(a) *Peltotrachelus pubes* (Faust) (b) *Amblyrhinus poricollis* (Boheman) (c) *Myllocerus discolor* (Boheman) Curculionidae	Adult weevils feed on flower buds and tender shoots of the plant.	Aug-May	40-60%	
Flower beetle	*Anatona stellata* Wlk. Cetoniidae	Adult beetles feed on flowers	Oct-Jan	5%	Minor incidence
Flower webbers	1. *Dichocracia punctiferalis* Guen. Pyralidae 2. *Acrobasis* sp. near *romanella* Mill Phycitidae 3. *Lectithocera* sp. near *metacusta* Meyr Gelechidae	Larvae webs the flowers and feeds from within	Oct-Feb	40-60%	Regular occurrence

Contd...

1	2	3	4	5	6
2. *Fruit feeders* :					
Nut borers	1. *Virachola isocrates* F. 2. *Virachola* sp. Lycaenidae	Larvae feed on the tender and green nuts resulting hollowed out seeds. Larvae feeds characteristically by plugging the hole with anal segments	Jan-April	60-80%	Sporadic
Plant buge	1. *Serinatha augur* Fabr. Coreidae 2. *Antilochus cogueberti* Fabr. Pyrrhocoridae	Nymphs and adults suck the juice from the ripened and fallen fruits	Feb-April	60-80%	Occasionally serious
3. *Leaf feeders* :					
	1. *Euproctis scintillans* W. Lymantriidae 2. *Syntomis divisa* Wlk. Euchromiidae	Larva causes defoliation	Sept-March	5%	Minor incidence
4. *Stem feeders* :					
Bark borer	*Indarbelatetraonis* Moore. Metarbelidae	Larvae feed on the bark by remaining inside the galleries	Throughout the year	40-60%	—

A perusal of the Table indicates that blossom webber (*Cydia* sp.) is the most destructive insect damaging flowers, tender nuts and twigs from Oct.–April resulting heavy flower and nut drop.

Tree bug *Tessaratoma javanica* Thumb and fruit feeders *Virachola isocrates* F., and *Virachola* sp. also occur in flowering and fruiting seasons i e. from Sept.-May and responsible for affecting the quantity and quality of the produce.

The soap-nut moth, weevils, flower webbers and bark borer were observed to cause moderate infestation to soap-nuts.

However, Ayyar (1944) reported the infestation of fruit piercing moth *S. partita* F. (*inara*, Cram) throughout the Deccan on *S. laurifolius* during August-October months. The remaining pests were of minor importance.

Acknowledgement

The author is grateful to Dr. K.M. Harris, Director, C.A.B., International Institute of Entomology, London for timely identification of the insect specimens and Dr. G.P.V. Reddy, Professor of Entomology, Agricultural College, Bapatla for encouragement and for providing facilities.

SUMMARY

Survey for the seasonal occurrence, nature of damage and intensity of infestation of insect pests of soap-nut around Bapatla revealed that blossom webber (*Cydia* sp.) is the most destructive pest causing very severe damage during October-April followed by the fruit feeders *Virachola isocrates* F., *Virachola* sp , *Serinatha augur* Fabr. and *Antilochus cogueberti* Fabr. from January-April. Soap-nut moth, soap-nut tree bug and weevils were of moderate importance.

रीठे (सैपिण्डस की जाति) पर लगने वाले कीड़ों की मौसमी उपस्थिति का प्रारम्भिक अध्ययन

ए० सुब्बाराव

सांराश

बपटला के आस-पास लगे रीठे के वृक्षों पर लगे कीड़ों को मौसमवार उपस्थिति, हानि का प्रकार और कीट महामारी के संक्रमण की चण्डता का सर्वेक्षण करने से पता चला कि सबसे विनाशकारी कीड़ा पुष्पजालक (साइडिया की जाति) हैं जो अक्टूबर से अप्रैल के बीच इसे भारी हानि पहुँचाता है जिसके पश्चात् क्रम में फल भोजी (वीराचोला आइसोक्रेटिस एफ०, वीराचोला की जाति, सेरीनाथा आउगुर फैब्र और एण्टीलोकुस कोगुबेर्टी फाब्र० आते हैं जो जनवरी-अप्रैल में हानि पहुँचाते हैं। रीठा-पतग, रीठा वृक्ष कीट और घुण मध्यम हानिकर कीट हैं।

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RESEARCH NOTE

USE OF LINEAR MEASUREMENT IN THE ESTIMATION OF LEAF AREA OF *BHALIA*

Moghania macrophylla (Willd) O. Ktze (*bhalia*) is a leguminous, erect perennial shrub which grows about 2.5 m in height (Lal *et al.*, 1976). It is found at lower elevations throughout India and in Andaman Islands (Anon, 1956). It is known to be one of the minor lac host of regional importance for growing both *kusmi* and *rangeeni* strains of lac insect (Srivastava and Kumar, 1982).

Leaves are the main assimilatory organs, chiefly conserned with Photosynthesis and the leaf area a reliable index for determining the overall metabolic efficiency of a plant in terms of dry matter accumulation, carbohydrate metabolism yield and quality of the crop. *Bhalia* leaves digitately trifoliate and shape of leaflets are eliptic accuminate. In such type of leaves, variation in area largely depends upon the length and breadth of the leaf blade. It is therefore, imperative to develop rapid accurate and non-destructive estimates of leaf area for this plant of commercial value. Various techniques have been used for measuring expanding leaf surface of the growing plant. Such methods include plotting the leaves lamina on centimeter graph paper and counting the square (actual leaf area), preparing blue prints of leaves and determining the area by planimeter and dry matter area basis of individual leaf (Rhoades and Bloodworth, 1964; Johnson, 1967) but these methods are time consuming and laborious. Some workers have used the length and breadth of the leaf multiplied by a constant with success. The earliest workers (Montagomery, 1911) who determined the leaf area of Maize by this method. But very little efforts have been made to study the leaf area of lac host plants. The present study deals with the development of simple, reliable and non-destructive method of calculating the leaf area of *bhalia* plant.

Thirty random samples leaflets length was measured to the nearest from the tip to the petiole, leaflet width was measured at the widest region across the leaflet at the right angle to the leaflet. Individual area of leaflet was also measured by using the graph paper and counting the squares. Leaflet area determined by length × breadth was higher in each case than the actual area of individual leaflet obtained from graphical method (Table 1). Hence, actual area was obtained by multiplying length × breadth × 0.746. The constant factor was estimated by dividing the sum of actual area (graphical method) of all the leaflets by the sum of products of length and breadth of these leaflets (Table 1). This factor did not vary much due to size, dimension, age and development of foliage. It, therefore, provides an important constant

Table 1

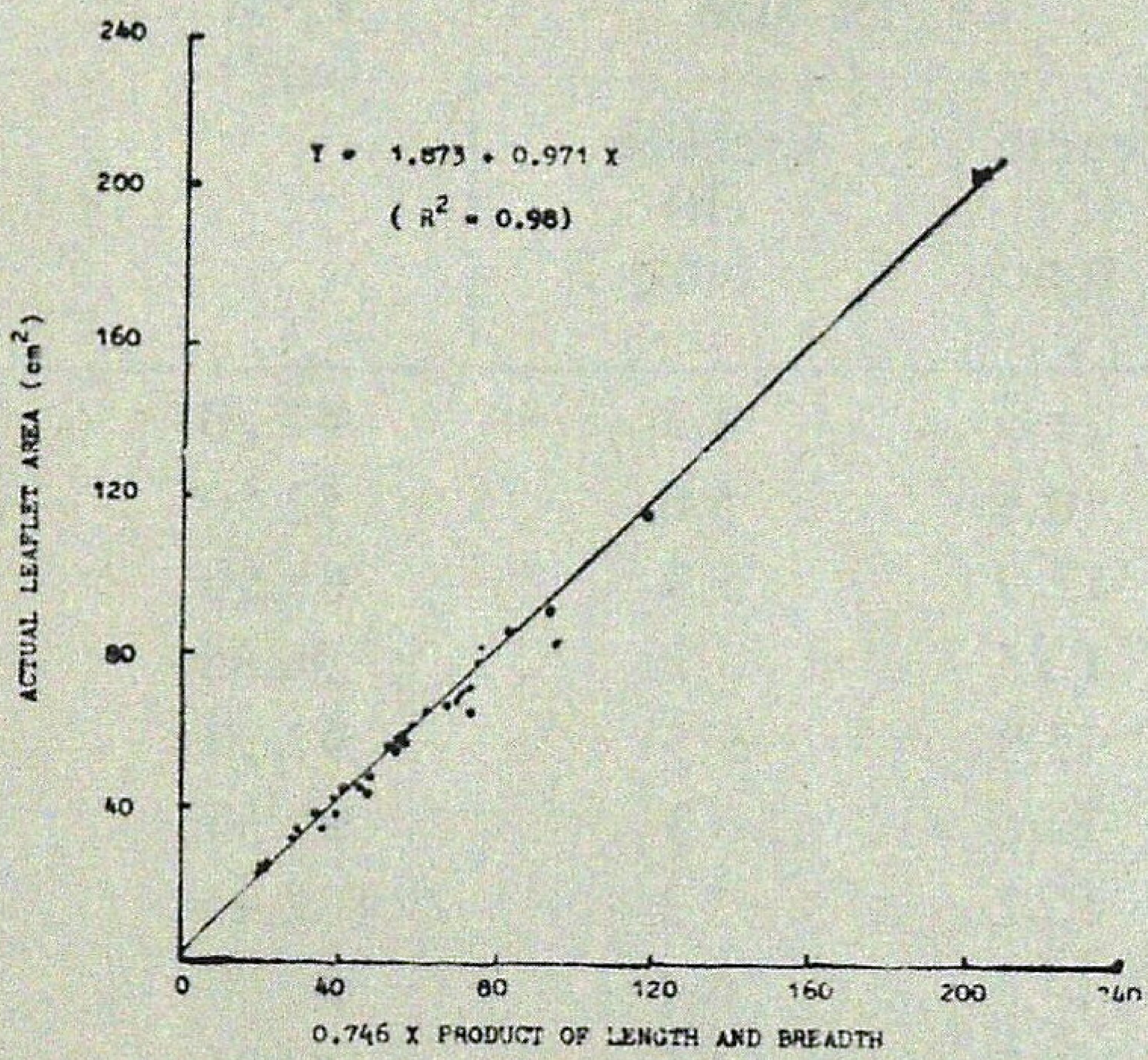
Length, breadth, actual and estimated area of leaflets of Bhalia.

Leaflet size		L×B (cm²)	Actual leaflet area (cm²)	Value of K (Constant)	Estimated leaflet area (L×B×K) (cm²)	Difference % (estimated from actual)
Length (L) (cm)	Breadth (B) (cm)					
11.0	4.3	47.30	34.43	0.727	35.28	2.52
10.5	5.0	52.50	39.06	0.744	39.16	0.25
12.0	5.3	63.60	45.31	0.712	45.28	0.06
10 5	3.7	38.85	32.39	0 833	28.98	10.52
15.0	6.5	97.50	64 47	0.661	72.73	12.81
14.5	6.3	91.35	66.60	0.729	68.14	2.31
15.2	7 2	109.44	85.02	0.776	81 64	3.97
14.5	6.4	92 80	67.43	0.726	69.22	2 65
10.5	4.5	47.25	37.85	0 801	35.24	6.89
14 0	6 0	84.00	64.73	0.770	62.66	3.19
15.5	8.0	124.00	91.28	0.736	92.50	1.33
24.0	11.5	276.00	201.17	0.729	205.89	2.35
15.5	6.5	100 75	82.11	0.814	75.15	8.47
14.5	6.5	94.25	68.69	0.728	70.31	2.36
13.0	5.7	74.10	55.20	0.744	55.27	0.12
18.4	8.5	156.40	116.24	0.743	116.67	0.37
14.8	6.9	102.12	77.83	0.759	76.18	1.74
15 0	6.5	97.50	70.53	0.723	72.73	3.11
13.4	5.8	77.72	58.27	0.749	57.97	0.51
8.3	3 5	29.05	22.57	0.776	21.67	3.98
13.0	5.8	75.40	57.66	0.764	56.24	2.46
12.8	5.8	74.24	55.80	0.751	55.38	0.75
12.5	5.3	66.25	47.15	0.711	49.42	4.81
12.4	5.8	71.92	55.45	0.770	53.65	3.24
11.8	5.2	61.36	44.17	0.719	45.77	3.62
13.6	5.5	74.00	54.25	0.733	55.20	1.75
10.4	4.4	45.76	34.55	0.755	34.13	1.21
10.3	4.6	47 38	34.15	0.720	35.34	3.48
11.5	4.8	55.20	44.42	0.804	41.17	7.31
10.7	4.9	52.43	41.80	0.797	39.12	6.41
13.3	5.9	82 68	61.68	0.746	61.60	3.97
2.92	1.49	44.97	32.07	0.027	33.59	3.21

for estimating the area exposed by a leaf on the growing *bhalia* plant. The estimated area of individual leaflet obtained by multiplying length × breadth × constant varied by 3.71% from the actual value and it is within the range of experimental error allowed for such biological measurements. Use of such a linear measurement is often less time consuming and does not require any expensive instrument.

It was further confirmed by correlation study that the 'r' value estimated (Fig. 1) revealed that the leaflet area calculated by the method using constant factor was the efficient one as compared to the graphical method of estimation. It is, therefore, evident that the leaflet area could be determined by simply multiplying the product of the leaflet length and leaflet breadth with constant factors of 0.746. Thus, the conclusion to be drawn is that the area of trifoliate leaf can be determined simply by adding the area of three determined leaflets.

Fig. 1



Relationship between actual leaflet area and estimated leaflet area
Regression equation
(shown by + s on scatter plot)

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FOREST NOTES AND OBSERVATIONS

Goat-Seeding

The International Conference on Goats held recently at New Delhi highlighted a new theory that the goats help in revegetating the land on which it wanders. Nobody has raised a voice against it in the forum. We are all aware that these omnivorous goats are called the "Land-Mowers". It is also a fact that in countries where goats are favoured for meat, milk and hides have left their land bereft of any vegetation leading to desertification. Even in India where goats are reared in villages have completely degraded the countryside. It could be argued that because of barren degraded lands the villagers preferred for economic reasons the rearing of goats rather than cows, buffaloes and sheep.

It is true that goats browse everything that they come across and do not allow any plant to grow and survive. It is, therefore, thought fit to ban goats in forests. Several countries have banned goat rearing. Our recent National Forest Policy also recommends to keep away goats from forest areas. When grazing itself in our country is free and uncontrolled even in our Reserved Forests and Protected Forests, the prevention of goats in our forests is next to impossible. The grazing policy has done a lot of damage to our forests and the natural regeneration of many important plant species are missing.

Stall feeding of cattle has been advocated all along but with little success. Aerial seeding has been tried for over a decade in our tropical country but has not given any desired results. Now we are in for "Goat-seeding". Goats could be fed with seeds of desired tree species and trained to move along contours to release droppings at regular intervals or in the pits or trenches dug by the forest department so that our barren lands could be revegetated faster and at less cost. A novel idea but unfortunately it was not mooted in the International Conference of Goats held at New Delh. This could be an ideal research topic on Capricorn.

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From the Indian Forester—One Hundred Years Ago

THE INDIAN FORESTER

June, 1892 (pp. 226-228)

A PLEA FOR OUR FEATHERED FRIENDS

Sir,

I venture to think that the utility of birds in the economy of nature has been somewhat underrated in the Indian Museum Notes, an extract from which appeared in your April number.

They are useful to mankind chiefly in the following ways :

1. In the destruction of agricultural pests.
2. In the dispersion of seeds of forest trees and shrubs.
3. For their aesthetic value.
4. For purposes of sport.
5. As a source of food supply.
6. As scavengers.

The immense value of insectivorous birds is, of course, undeniable, but it is not universally the case in this country that few of them are ever destroyed for the sake of their plumage. A list of birds shot for this purpose in the Dehra Dun District was prepared in 1885 by Mr. Clifford, Assistant Conservator of Forests. It comprised no less than 235 distinct species, including birds from nearly every one of the insectivorous families mentioned in the Notes.

I am not at all sure that many of the birds which are both grain and insect feeders, do not do more good through the insects they destroy, than harm through the grain they devour. I remember a celebrated case in some large German province where the farmers had to spend money in re-introducing such birds, which they had previously ruthlessly exterminated.

The important aid afforded by birds in the propagation of plants, more particulary those bearing succulent fruits, is not, I believe, fully realized. It has been admitted that birds are one of the chief agents in gradually clothing recently formed islands with vegetation, but it is apt to be overlooked that this process of distribution in also daily going on, although in a less striking manner, on all lands throughout the world. In this utilitarian age, in which the struggle for life is so acute, and where, alas ! in many instances, all is subordinated to L.S.D., everything that tends to raise man's thoughts above the counting house, should be most strenuously preserved. Of all animal life, birds probably give the greatest pleasure to humanity, by their beauty of form and colour, the marvel of their flight, and in many cases the sweetness

of their song. How often have they inspired our poets and artists ? Where would the art of Japan be without them ? The different effects on the mind of an Indian Jungle teeming with bird and animal life, and of a New Zealand Forest, with its death-like stillness, requires to be felt to be believed.

I wish also to put in a word for sport. There is very little to be said in favour of the big *battues* which in England have but too often taken the place of the good old style, and I should be the last to wish that anything of the sort should be encouraged in India at the expense of the agriculturist. But sport in India, as now conducted, has everything in its favour; it is a healthy and manly form of exercise; it helps to keep body and mind in full vigour; and greatly relieves the monotony of existence in many of our rather dull Indian Stations; it takes men out of large towns and Cantonments and brings them face to face with Nature. I believe, therefore, its value to Government and to the country to be very great indeed. Game birds, too, are found mostly in the wilder parts of the country where there is but little cultivation, so that their depredations on the cultivator's grain are not usually serious.

As a source of food supply, wild birds are not of a very high importance; but still in India, where meat is so inferior, they are a pleasant addition to the ordinary fare and deserve consideration even on this account.

Vultures, so disagreeable in themselves, are of the highest value as scavengers, and crows also are very useful in this respect. I would by no means wish to see all crows and starlings condemned to destruction on the ground that they do more harm than good. Crows, besides their duties as additional sweepers, are, I believe, most useful in destroying such agricultural pests as wire worms in which they are ably assisted by mynahs and starlings, a small body of whom may, generally be observed following the Indian plough. Even the rose-colored starling which is often so destructive to grain, is sometimes of the greatest service, the *Pioneer* states that "the flights of locusts which were so prevalent last year have almost all succumbed to the combined attack of insect parasites and Rosy pastor starlings". This bird also helps in the reproduction of the mulberry.

I would say, then—let us try and preserve all birds except those whose criminality has been proved to the hilt. It is with sorrow that I am forced to condemn the noisy but destructive, although beautiful, parrots. I would also declare war a *l'outrance* against the hawks and kites.

The birds in India are one of the glories of the country, and bird-life is abundant almost everywhere. Is there not a danger in the future that with the increase in the number of cheap fire-arms and their possession by numerous unscrupulous sportsmen *a la francais*, this glory may become a thing of the past ? I should therefore rejoice to see a Wild Bird Preservation Act passed by the Government of India, on the lines of the English Act, but modified to suit the requirements of the country. The Act should, in my opinion, be very general, with powers to the various Local Governments to make rules under it, applying the act to certain areas, fixing the close seasons, and so forth.

TAU THA.

LETTER TO THE EDITOR

To,

The Hony. Editor,
Indian Forester,
P.O. New Forest,
Dehra Dun (U.P.)

Sub : *Melocanna bambusoides* (Muli) (*Indian Forester*, July 1991, p. 583)

Sir,

"Occurrence" of Muli bamboo in East Sikkim (Singtam) is interesting. Some forty years back, I had spent a few months in Rangpo-Singtam region, in connection with the preparation of the first working plan of Sikkim forests. Of course, no Muli was to be seen there or anywhere else in Sikkim then. It must have been a later introduction. In the adjacent Darjeeling foothills, of course, Muli had been introduced more than a century ago (by F.D.) and many Terai tea gardens followed suit.

Yours faithfully,

Sd/- K.C. Roy Choudhury,
Chief Conservator of Forests (Retd.)
Calcutta (West Bengal)

GAZETTE NOTIFICATIONS

ANDHRA PRADESH GAZETTE

The services of Shri Hitesh Malhotra, IFS., Conservator of Forests, Field Director, Project Tiger, Srisailam are placed at the disposal of Social Welfare Department for appointment as Vice Chairman and Managing Director, Girijan Co-operative Coffee Development Corporation, Paderu, Visakhapatnam initially for a period of one year on the usual terms and conditions of deputation.

On repatriation from Singareni Collieries Company Limited, Shri Rajesh Mittal, IFS., is posted as Principal, A.P. School of Forestry, Yellandu, in the existing vacancy.

KARNATAKA GAZETTE

The services of Shri B.K. Gowda, IFS (IR 64½) General Manager, Karnataka Forest Development Corporation, Bangalore is withdrawn from the Animal Husbandary, Fisheries and Forest Department and he is appointed with immediate effect and until further orders as Conservator of Forests, Bangalore Circle, Bangalore vice Shri S. Jogaiah, IFS, transferred.

The services of Shri S. Jogaiah, IFS (SFS 69) Conservator of Forests, Bangalore Circle, Bangalore are placed at the disposal of Animal Husbandary, Fisheries and Forests Department with immediate effect and until further orders for appointment as General Marager, Karnataka Forest Development Corporation, Bangalore vice Shri B.K. Gowda, IFS, transferred.

Shri S. Parameswarappa, IFS (IR 1963), Principal Chief Conservator of Forests, Karnataka, Bangalore is appointed with immediate effect and until further orders as Principal Chief Conservator of Forests (Development), in the newly created post.

Shri N.V. Ramachandra Chetty, IFS (IR 1964), Principal Chief Conservator of Forests-II, Karnataka, Bangalore is appointed with immediate effect and until further orders as Principal Chief Conservator of Forests (Management), Karnataka, Bangalore in the redesignated post vice Shri S. Parameswarappa, IFS, transferred.

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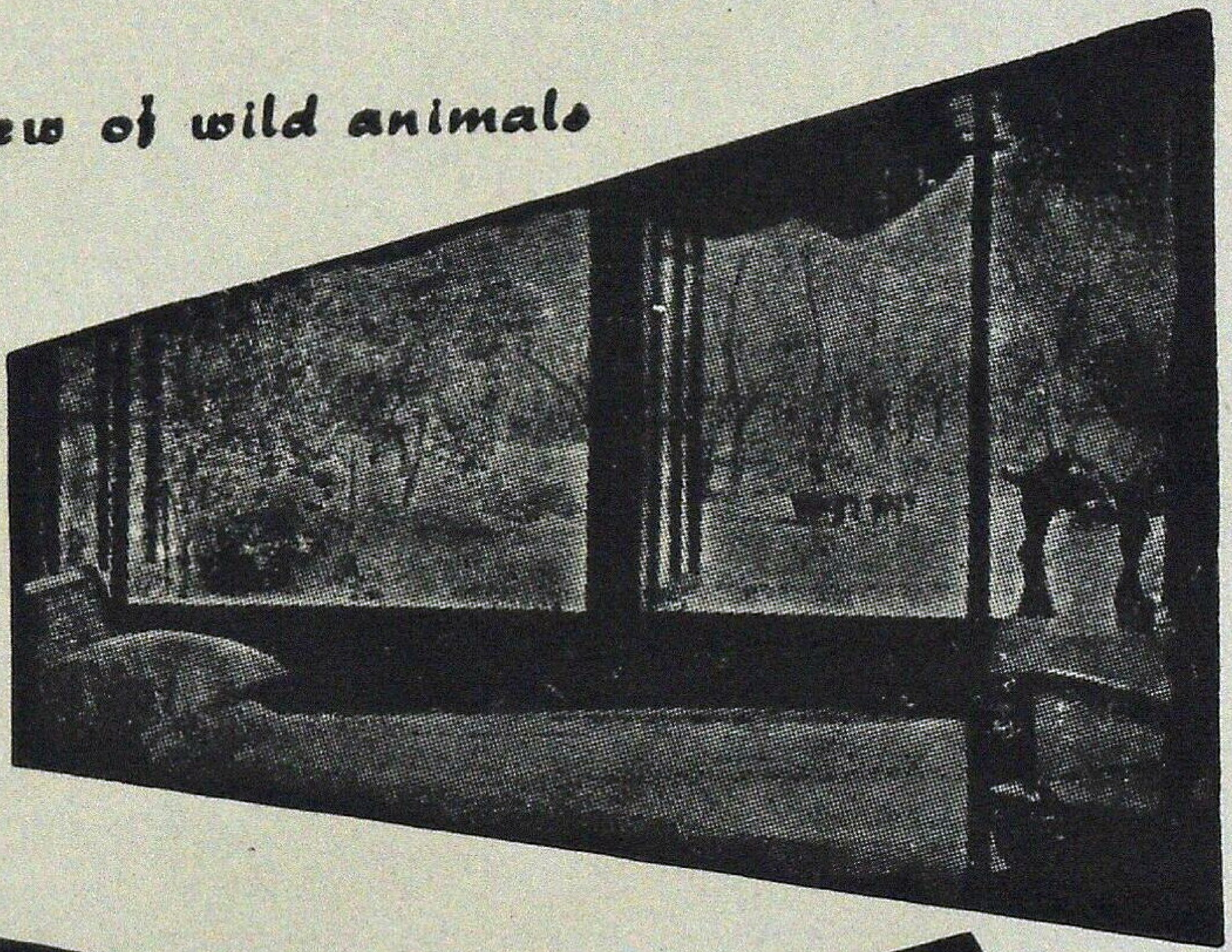

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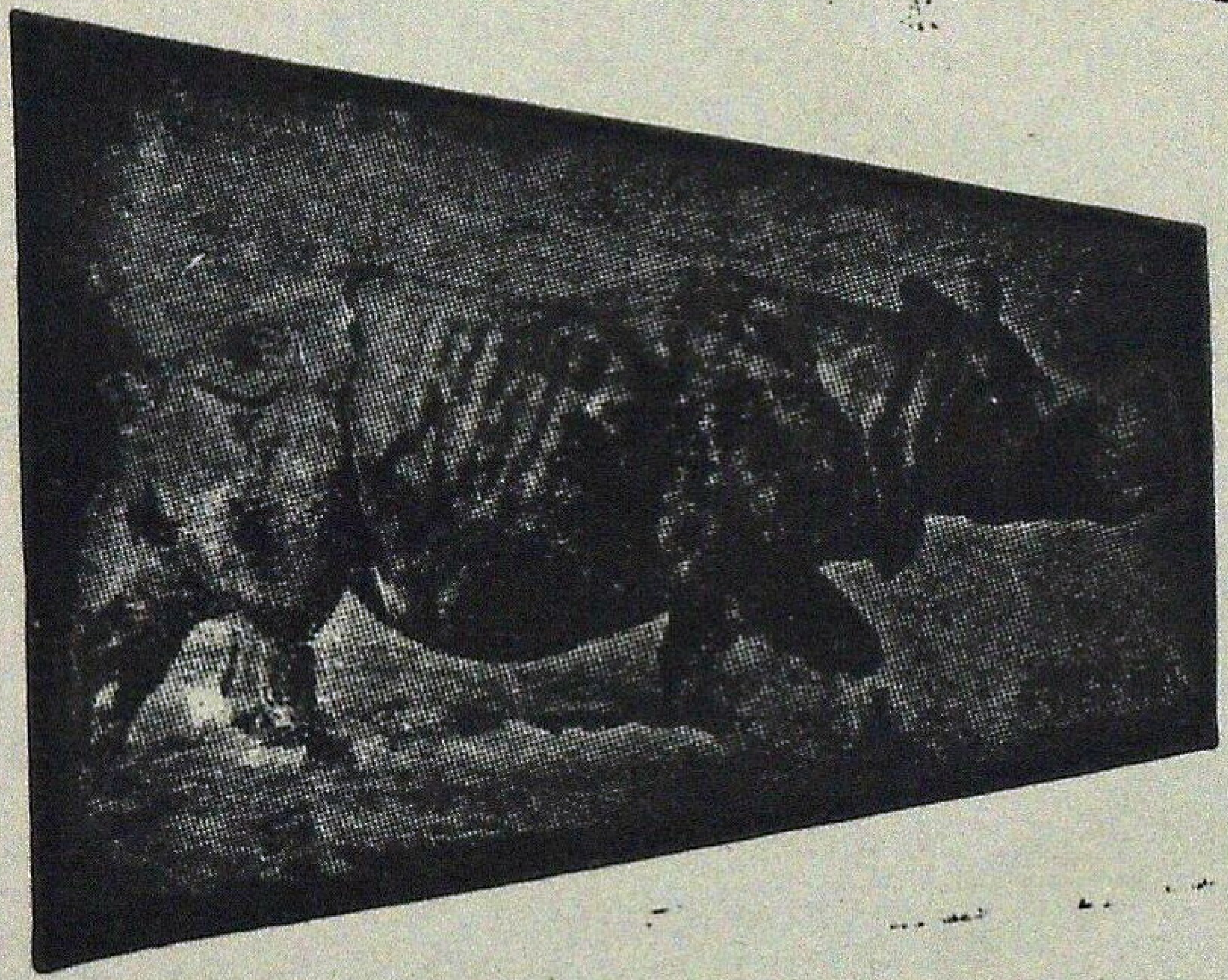

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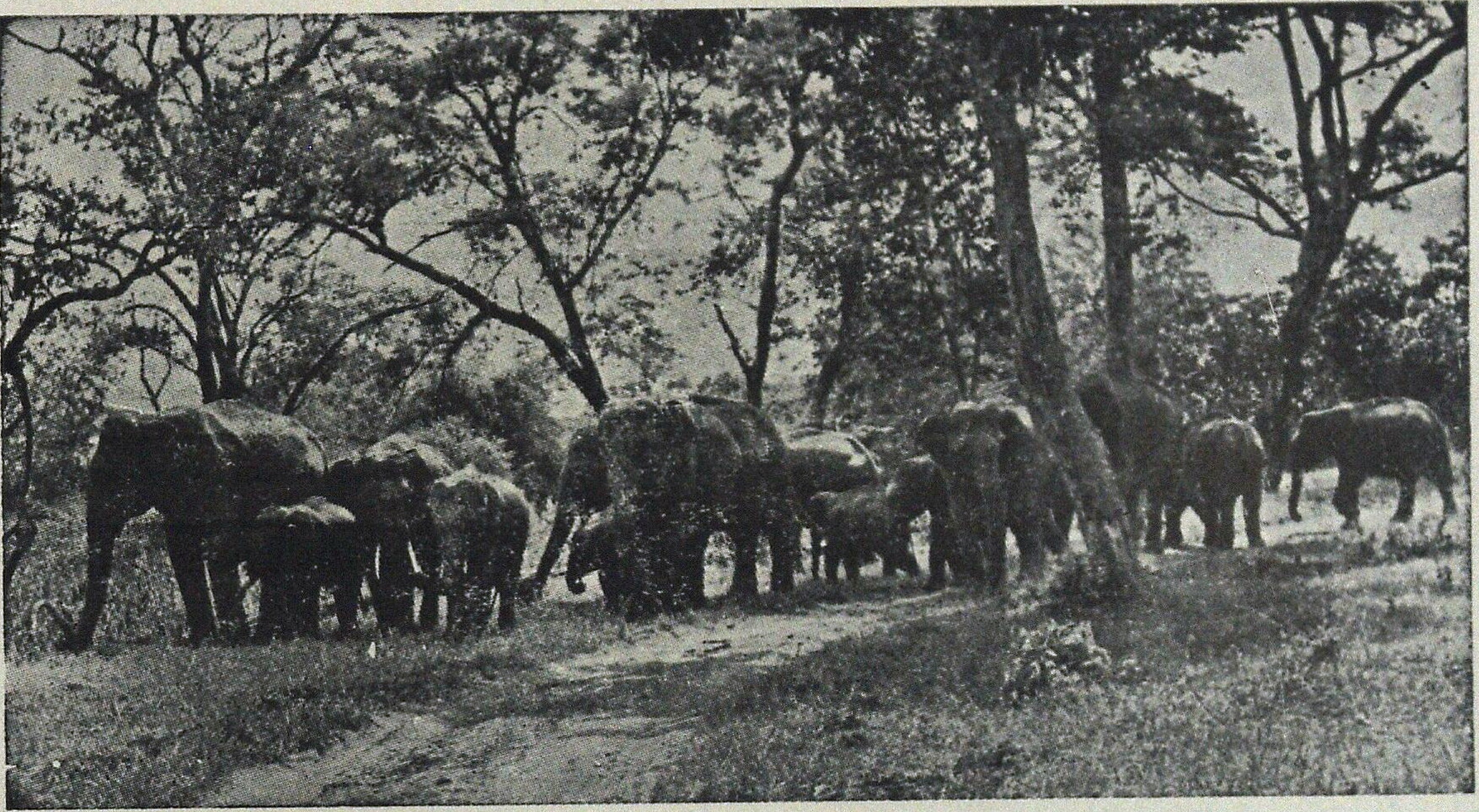

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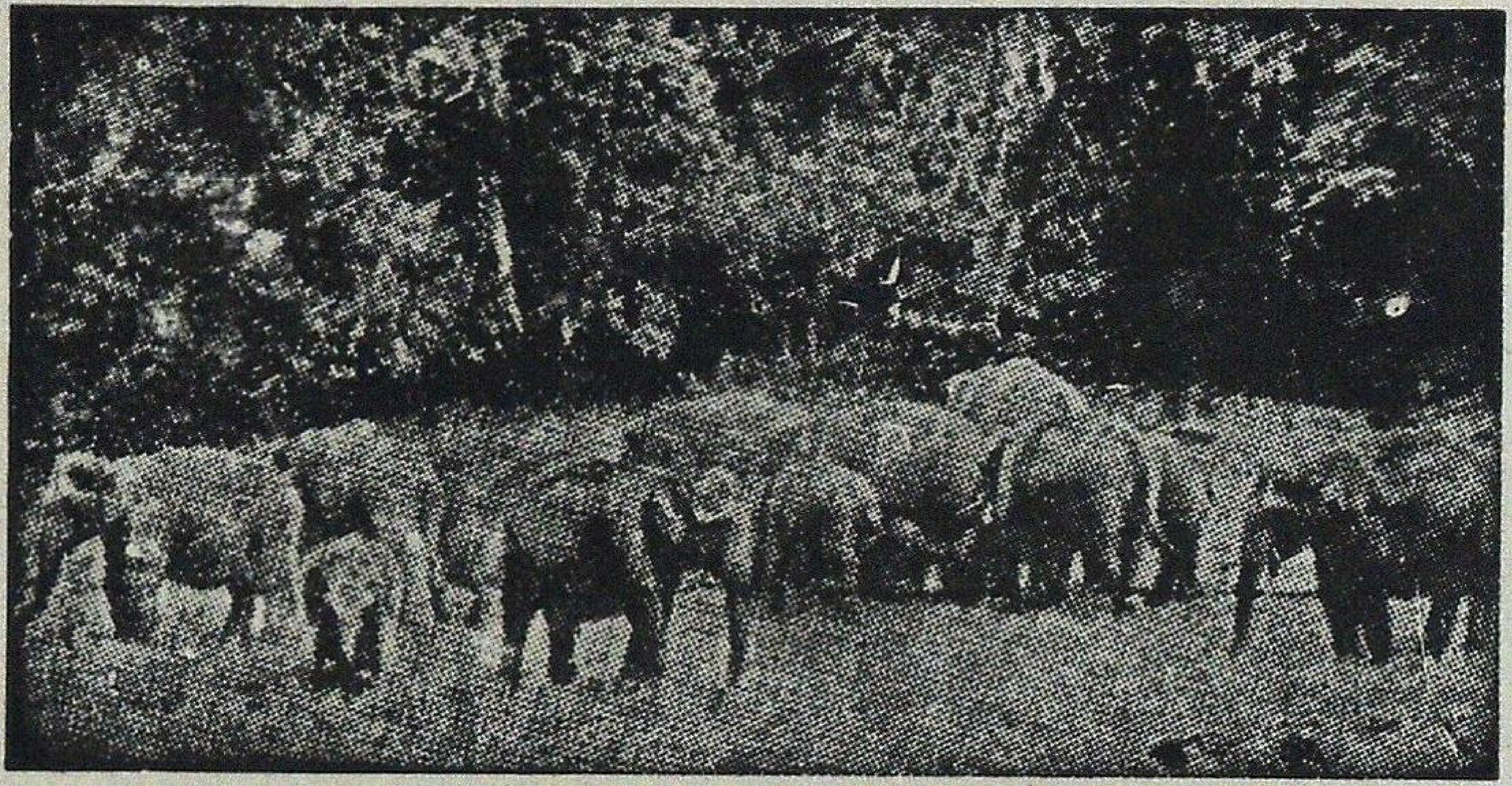

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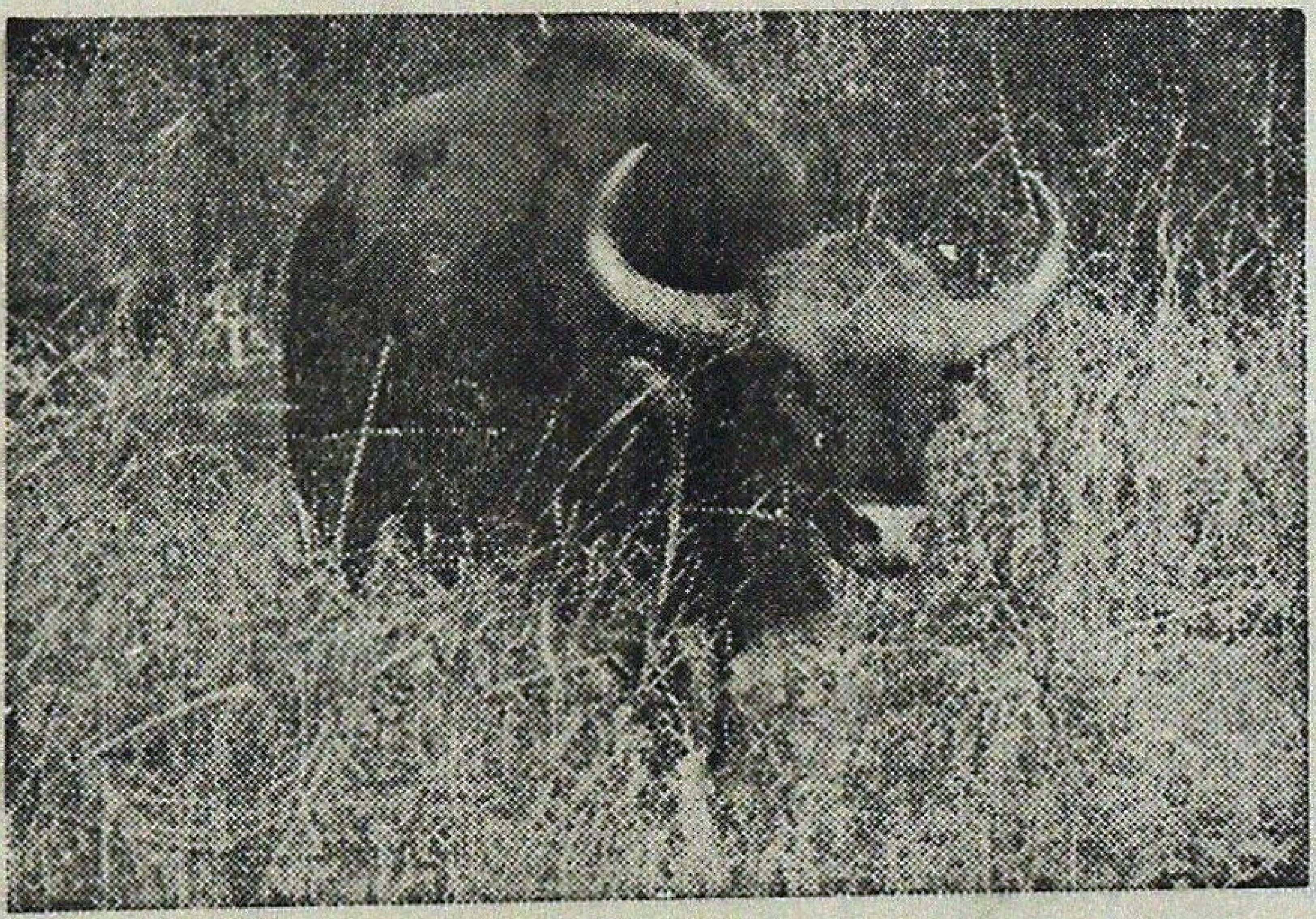

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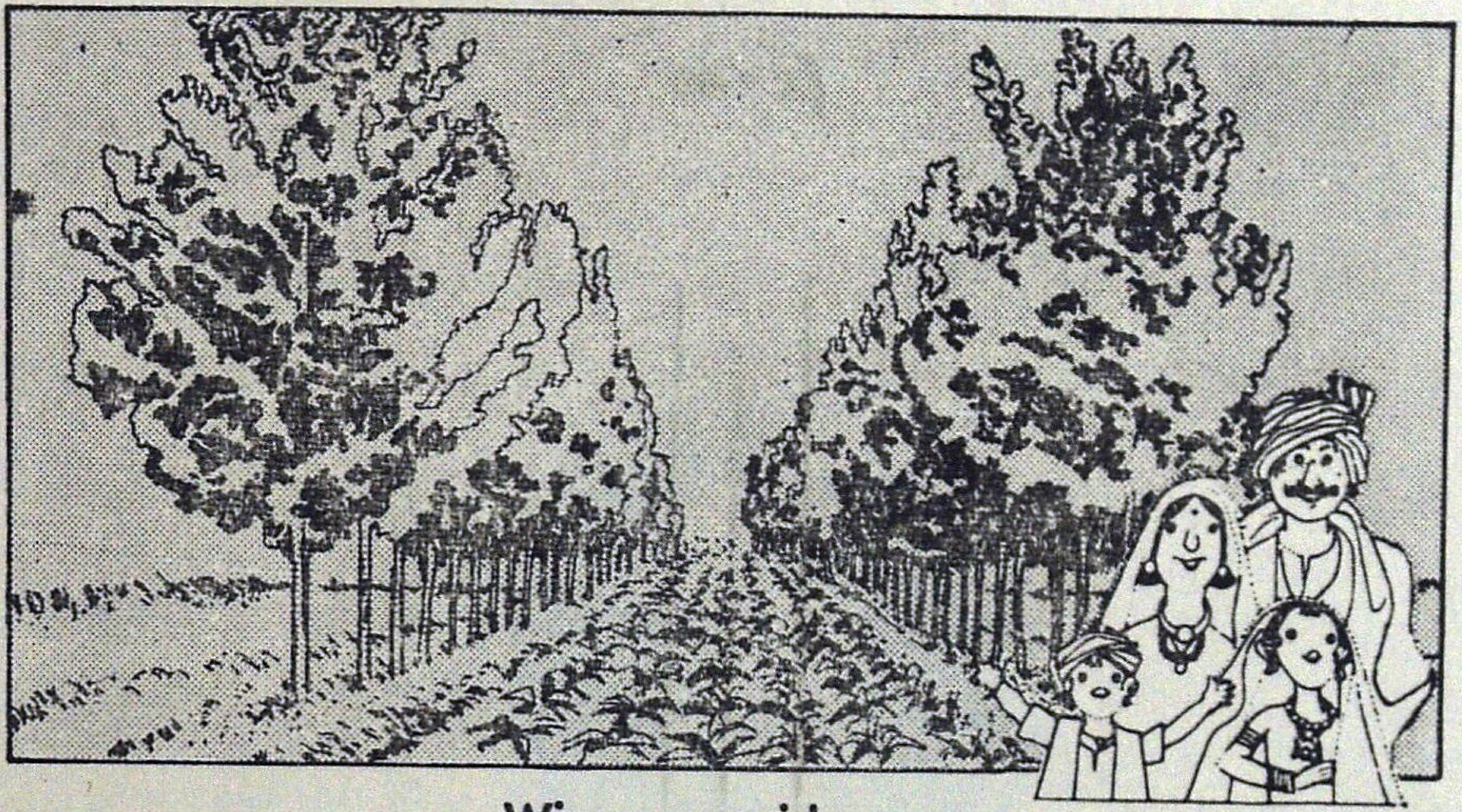

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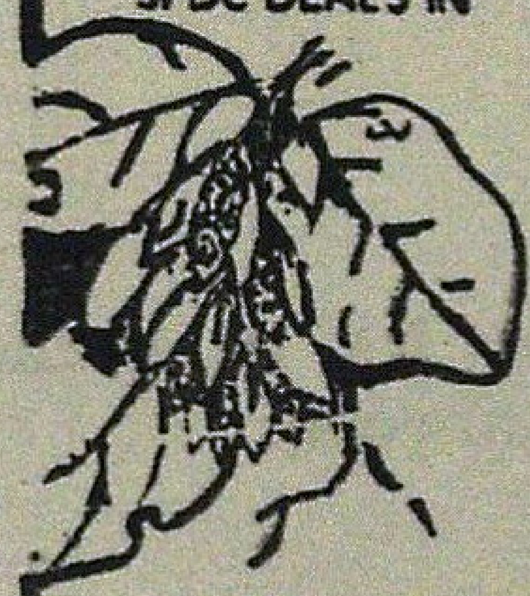

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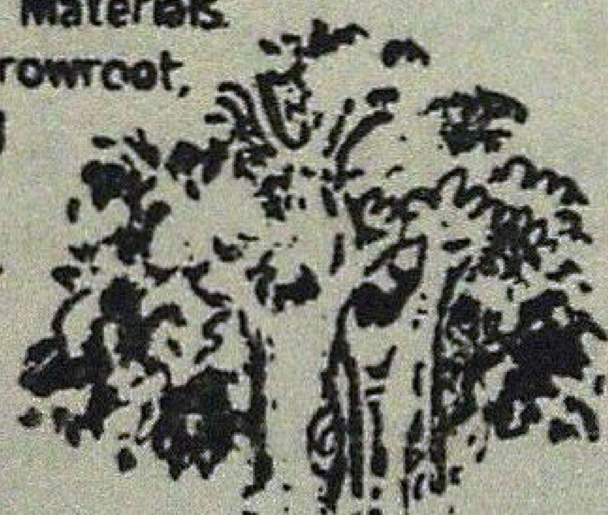

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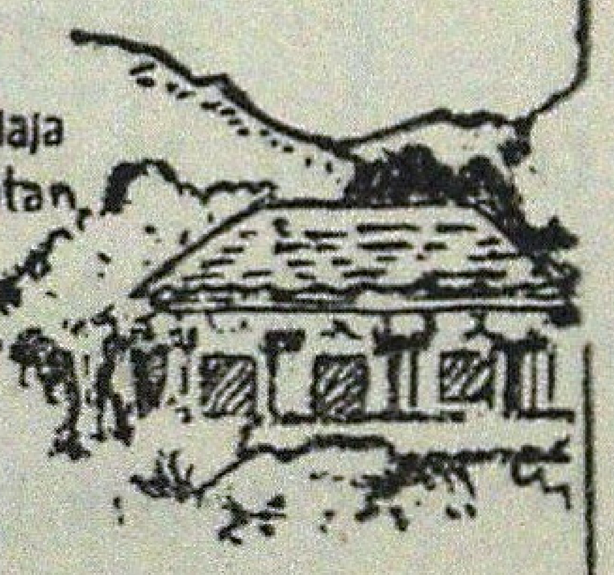

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